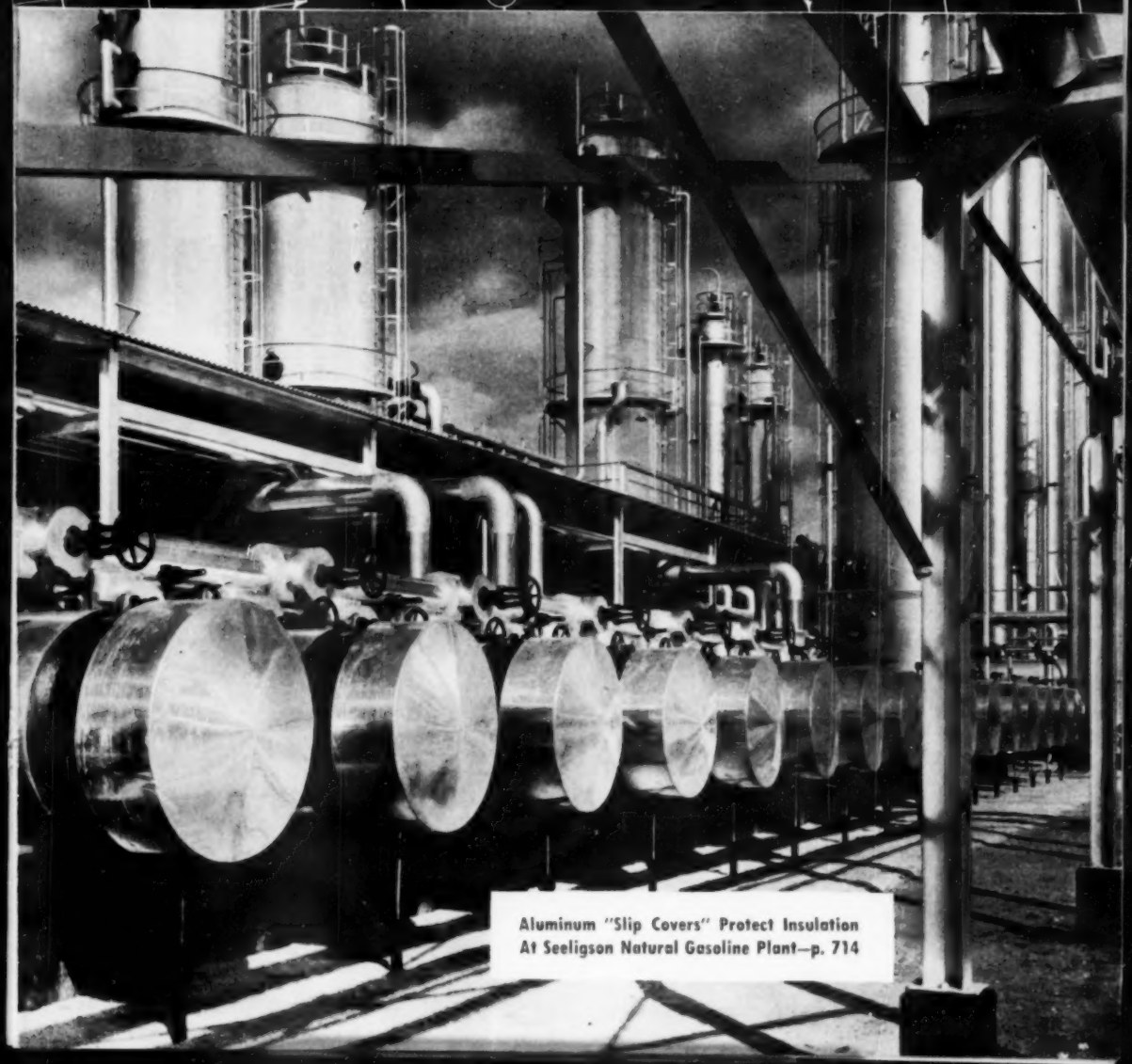
JULY, 1950
VOL. 5, NO. 7

PETROLEUM PROCESSING



Aluminum "Slip Covers" Protect Insulation
At Seeligson Natural Gasoline Plant—p. 714

13 in '49

THE *Seeligson Plant*

pictured below, is the largest of 13 gas processing plants completed by HUDSON and placed in operation during 1949. The experience and pride in workmanship which went into the design and building of these 13 projects is evidenced in the complete satisfaction of their Owners and Operators.

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TWO WAYS of evaluating the effectiveness of "LEAD"

ONE WAY

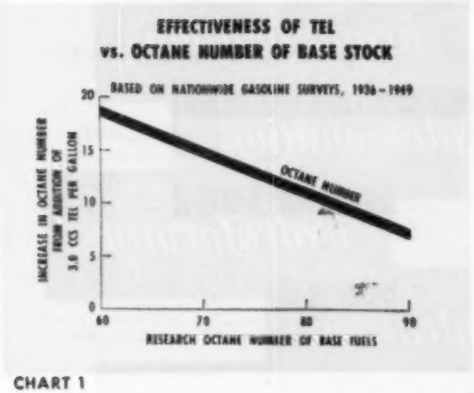
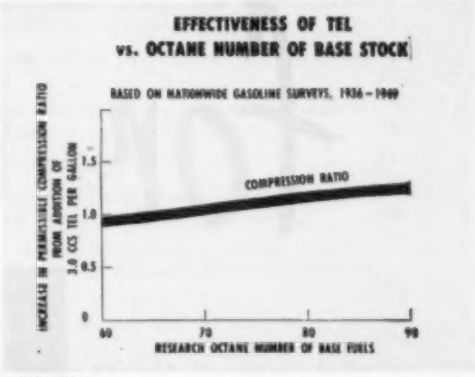

EFFECTIVENESS OF TEL
vs. OCTANE NUMBER OF BASE STOCK
BASED ON NATIONWIDE GASOLINE SURVEYS, 1936-1949
INCREASE IN OCTANE NUMBER FROM ADDITION OF 3.0 CCS TEL PER GALLON
OCTANE NUMBER
RESEARCH OCTANE NUMBER OF BASE FUELS

CHART 1

A BETTER WAY


EFFECTIVENESS OF TEL
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BASED ON NATIONWIDE GASOLINE SURVEYS, 1936-1949
INCREASE IN EFFECTIVE COMPRESSION RATIO FROM ADDITION OF 3.0 CCS TEL PER GALLON
COMPRESSION RATIO
RESEARCH OCTANE NUMBER OF BASE FUELS

CHART 2

THERE are two ways of looking at the effectiveness of tetraethyllead in improving the antiknock quality of base fuels:

- **One way—the usual way—is in terms of the increase in octane number as shown in Chart 1.**
- **A better way is in terms of the permissible increase in compression ratio of engines as shown in Chart 2.**

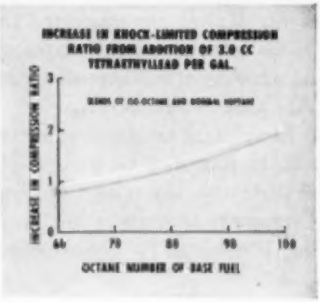
Chart 1 shows that as the antiknock quality of commercial base gasolines has gone up (during the years 1936-49), the increase in octane number units due to addition of tetraethyllead has become smaller.

Chart 2 shows that as the antiknock quality of base fuels has gone up, the increase in compression ratio permitted by the addition of tetraethyllead has actually become greater. For the refiner seeking the most economical means of meeting the increased compression ratio of automobiles, this is the realistic way of looking at tetraethyllead effectiveness.

An even more striking illustration of the greater effectiveness of tetraethyllead, when added to fuels of higher antiknock quality, is provided by Chart 3. In this case the base fuels are mixtures of normal heptane and iso-octane in different proportions. When added to the 60 octane fuel, 3.0 cc tetraethyllead allows an increase of 0.9 compression ratio, but the figure increases to 1.66 when the same quantity of tetraethyllead is added to a 90 octane fuel.

The unusually large improvement in effectiveness of tetraethyllead with increase in fuel antiknock quality, as illustrated in Chart 3, is obtainable with fuels having a considerable range of hydrocarbon composition. Later messages in this series will deal with the effectiveness of tetraethyllead when added to the four basic types of fuel hydrocarbons. Such studies serve to explain the varying behavior of tetraethyllead in commercial gasolines. More important, they point the way toward a more effective use of tetraethyllead in the future.

CHART 3


INCREASE IN KNOCK-LIMITED COMPRESSION RATIO FROM ADDITION OF 3.0 CC TETRAETHYLLEAD PER GAL.
BLENDS OF ISO-OCTANE AND NORMAL HEPTANE
INCREASE IN COMPRESSION RATIO
OCTANE NUMBER OF BASE FUEL

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[To obtain more data on advertised products see page 762]

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[*To obtain more data on advertised products see page* 762]

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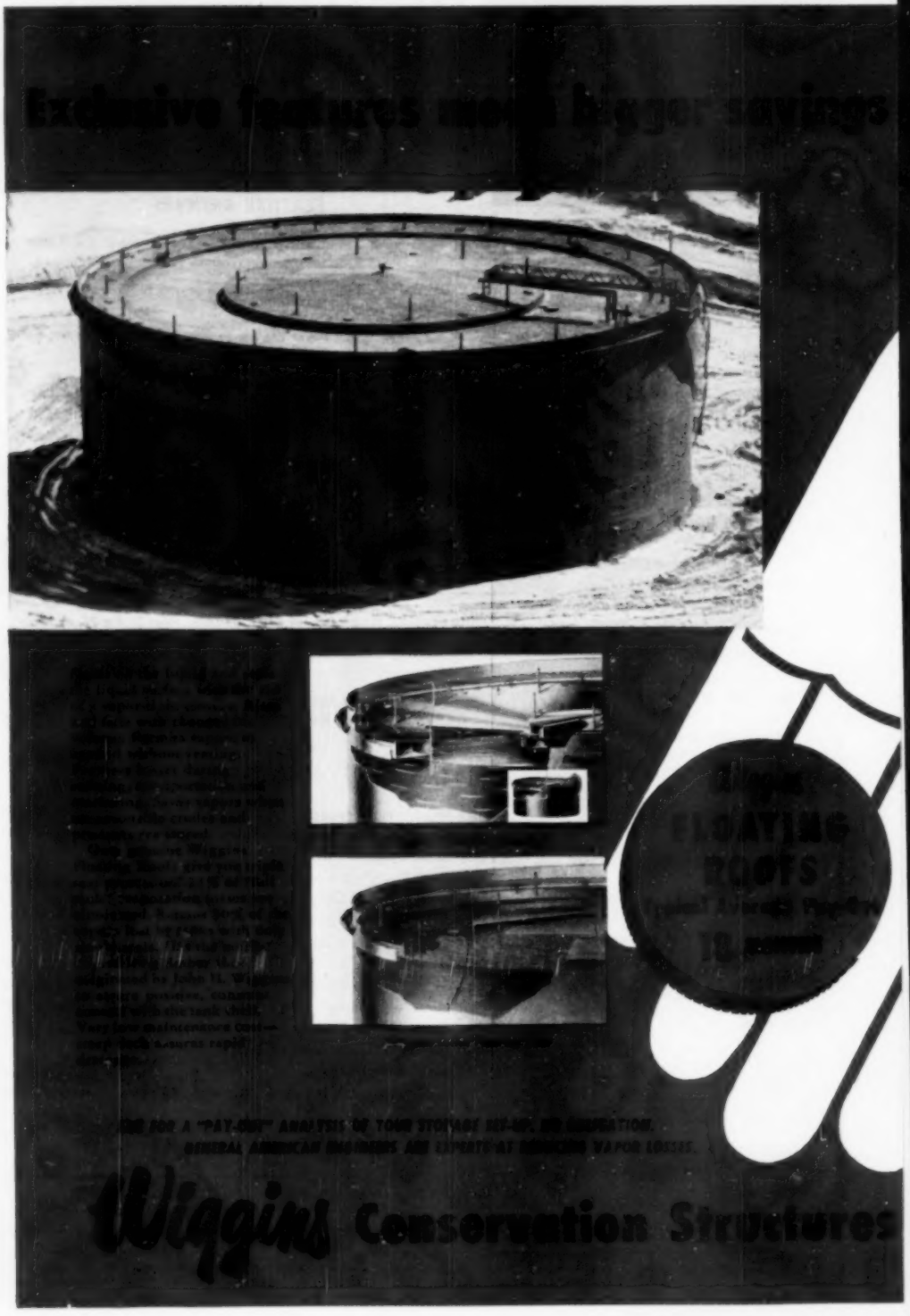
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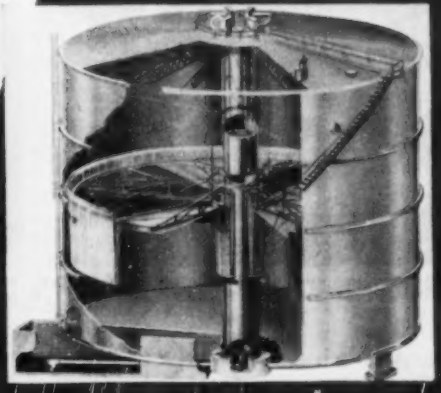

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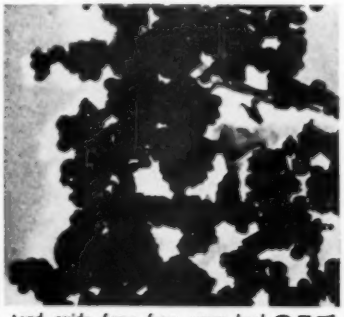

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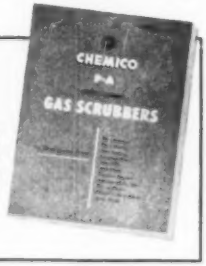

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[*To obtain more data on advertised products see page* 762]

What's Happening!

Important Current News Summarized for Refiners

EXPANSION

Johnson Oil Refining Co. will install a Platforming unit at its 6,000 b/d refinery at Cleveland, Okla., to be in operation by Jan. 1, 1951. Unit will have a capacity of 1,800 b/d and process a predominately straight-run stock of 200-375° F. boiling range. The unit is now in blueprint stage, and design and installation are under supervision of Universal Oil Products Co.

Bell Oil & Gas Co. also has contracted with U.O.P. for a Platforming unit—1500 b/d nominal charging capacity—to be built at its Grandfield, Okla., refinery. Unit will charge a mixture of straight-run and cracked gasoline from the 6,000 b/d refinery, and is expected to be completed and placed in operation this Fall.

Dow Chemical Co. is planning to install its second Hypersorption unit for the recovery of light hydrocarbons at Midland, Mich. Unit will be built by Foster Wheeler Corp., and will have a charging capacity five times that of the first unit, which has been operating successfully since May, 1947, and has a daily design capacity of 1,800,000 SCF of feed gas. Three product streams— C_1's and lighter from the top, C_2's as the middle cut, and C_3's and heavier as the bottom fraction—will be separated. Dow in the past has obtained its light hydrocarbons by cracking Michigan crudes very highly, and presumably this source will supply feed stock for the new Hypersorber.

Pan American Refining Corp. has completed its new research building at Texas City. The one-story structure, built by H. K. Ferguson Co., provides an additional 10,000 sq. ft. of floor space for research uses.

• • •

FOREIGN

Two new catalytic cracking units are slated for France. Compagnie Francaise de Raffinage (CFR) plans to install one at its La Mede refinery near Marseilles (plus a gas recovery system at its Gonfreville refinery near Le Havre). Standard Francaise des Petroles (SFP) plans to put the other in at its Jerome refinery near Le Havre. Both projects are estimated to cost around $10,000,000 each, with ECA financing $2,850,000 of the former and $1,750,000 of the latter.

Societa Permollo plans to install new cracking units at its Rome and Genoa refineries, increasing output of light products at expense of fuel oil. A lube oil unit is also planned at its Milan refinery. Total cost of three projects is estimated at $4,984,000, of which ECA will underwrite $1,534,000.

• • •

SYNTHETIC FUELS

Extension of government's program of synthetic liquid fuels research for another three years has been recommended by Interior Secretary Chapman, and a bill based on that recommendation has been introduced in the House of Representatives (H. R. 8975) by Representative Peterson of Florida. Bill would also authorize an additional $25,000,000 in funds.

Chapman, in letter to Congress, urged continuation of the program on the grounds that "further technological and scientific research is required to demonstrate the commercial feasibility of the processes" of converting coal and oil shale into liquid fuels.

Present program was authorized in 1944 for a period of five years, and later extended for another three years—until April 5, 1952. A total of $60,000,000 has been authorized for that period.

• • •

MARKETS, PRICES

Rising price trend for petroleum products which got under way in May continued throughout June, with sharp gains registered for a wider variety of refined oils in the majority of refinery and terminal markets east of the Rockies. A quick look at the industry's statistical picture, based on most recent figures available from various sources at PETROLEUM PROCESSING press time, points up the strength back of the rise.

The following are days' supply figures of principal products in primary storage, in transit, and in pipe lines as of late June, with comparable year-ago figures in parentheses: finished and unfinished gasoline, 40 (42); kerosine, 91 (129); gas oil and distillate fuels, 62 (97); residual fuels, 31 (54).

Refined gasolines were up 0.125 to 0.25c per gal., with regular-grade priced on the low side at 10.125c, Group 3, and 11c for cargo lots at the Gulf. Heavy

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

fuel was up 5c per bbl. to $1.65 in the Group, while higher prices at the Gulf were in the form of "premiums" of 5 to 20c per bbl., paid above the $1.65 postings of two major suppliers. Natural gasoline jumped 0.25c late in the month, to 5.375c, Group 3, 4.875c Breckenridge.

Lubricating oils experienced what some trade sources described as the "fastest switch from a long to a short position" ever witnessed. Here again increased demand as evidenced by declines in stocks was the answer. Inventories of Pennsylvania and Mid-Continent bright stocks at the end of May were only a little more than half of what they were at the same time in 1949. Pennsylvania bright stock was up 1c a gal. to 19c. In the Mid-Continent conventional bright rose 0.5c to 18c, while solvent refined stock was up 2.5c to 22c per gal.

Crude Price Highlights: Pennsylvania grade crudes advanced 10c per bbl. with top grade, Bradford-Allegany, priced at $3.75. California heavy crude advanced by Standard of California, effective June 29, with 14 gravity oils boosted 15c per bbl. and lesser increases made for other gravities up to 25 gravity.

• • •

NATURAL GASOLINE

Shell Oil Co. has completed its Provident City, Texas, natural gasoline plant but will not operate it for several months until a gas pipeline can obtain the necessary pipe to connect to the plant. The new plant can process 60,000 Mcfd. of gas, recovering 2500 gal. daily of liquid products and supply 50,000 Mcfd. of dry residue gas for pipe line delivery.

North Cowden natural gasoline plant (near Odessa, Texas) was officially opened July 1. The plant, operated by Stanolind Oil & Gas Co. for a group of 21 owners, is capable of extracting 150,000 gal. daily of liquids when processing 50,000 Mcfd. of gas. Included are 35,000 gal. of propane, 23,000 gal. of butane, and 93,000 gal. of 26-lb. natural gasoline. Gas throughput can be doubled when field production warrants merely by installing certain items of equipment.

• • •

PETROCHEMICALS

A new synthetic fiber, a condensation polymer obtained from ethylene glycol and terephthalic acid, is now being tested on an experimental scale by Du Pont. The fiber first was developed in England, where it bears the trade-mark "Terylene" (April, 1949, p. 368). Du Pont acquired U. S. rights in 1946, and is tentatively indentifying it as Fiber V. The material is said to have high tensile strength, high resistance to stretching—both wet and dry, and good resistance to degradation by chemical bleaches and to abrasion.

Ethylene glycol for antifreeze will be the main product of the new $17,000,000 plant Mathieson Hydrocarbon Chemical Corp. plans to build near Brandenburg, Ky., ("What's Happening," May, p. 448). According to a stock prospectus recently filed by the company with the Security Exchange Commission in Washington, that and other chemicals will be made from ethane by cracking and chlorination.

A new synthetic rubber, a butadiene polymer requiring no styrene, has been developed by Phillips Petroleum Co. in cooperation with the Office of Rubber Reserve. Limited road tests, Phillips claims, indicate the new rubber is superior to GR-S synthetic rubber and perhaps to natural rubber for tire treads. It may even be equal to "cold rubber" in quality. More details in this issue, p. 694.

• • •

TRANSITION

Continental Oil Co. moved its executive offices from Ponca City to Houston July 1. Company's general offices will remain in Ponca City, where Continental's largest refinery is located, but top executives will be located in Houston.

Sunray Oil Co.'s 7,000 b/d refinery at Santa Maria, Calif., was put out of operation Friday, June 30 by an explosion and fire. The blast killed two workers, wrecked two distillation towers, and burned two storage tanks.

• • •

MISCELLANY

"Packaged" catalytic cracking units are now available in two sizes—3,000 b/d and 6,000 b/d. They employ Socony-Vacuum's TCC (Thermofor) process, and are said to cost only $100-125 per bbl. of capacity. The units will be shop-fabricated by Southwestern Engineering Co. of Los Angeles, and shipped to the refinery site ready for installation with a minimum of field work. More details in this issue, p. 711.

Surge in catalyst demand has been recognized by three manufacturers. Filtrol Corp. plans to build a $2.5 million plant in the West, with the following sites being considered: Salt Lake City and Eureka, Utah, and Henderson, Nev. American Cyanamid will begin construction soon on a $3 million plant at East Chicago, Ind., with estimated capacity of about 1500 tons/month, chiefly the microspheroidal type; facilities to be in operation about mid-1951, it is expected. Davison Chemical Corp. is converting a part of its Cincinnati production from ground type to microspheroidal form, with production anticipated to be under way by October, 1950.

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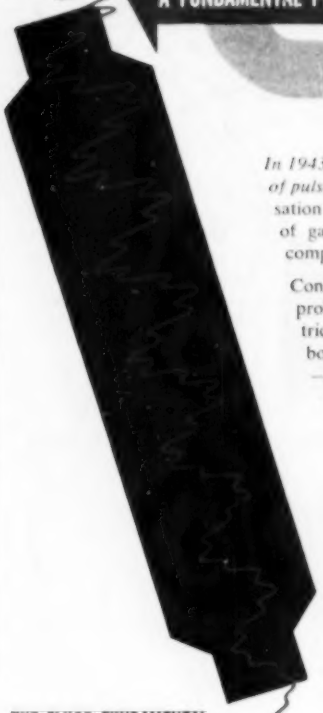

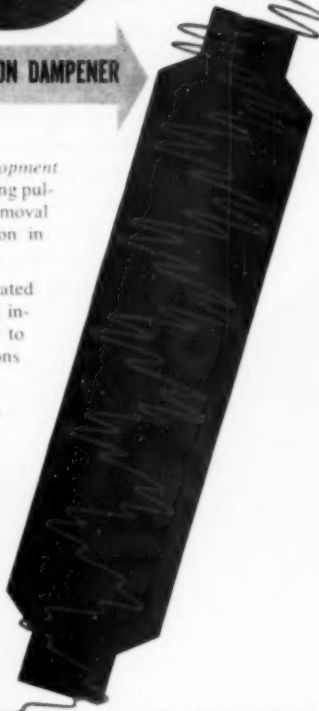

In 1943, The Fluor Corporation pioneered the development of pulsation dampeners. The first U. S. Patent covering pulsation dampeners designed specifically for the removal of gas stream pulsation and subsequent vibration in compressor piping was issued to Fluor in 1946.

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Tomorrow

. . . IN PETROLEUM TECHNOLOGY

By B. H. WEIL, Atlanta, Ga.
Editor, "Monthly Summary of Industrial Developments"

Brief Reviews of Current Technological and Economic Developments, Reported in the Light of Their Possible Effect on Future Petroleum Processing Operations

Ayres Foresees Energy Demand Increased 50% in 50 Years

ALTHOUGH supply has again caught up with an exceeded demand as regards petroleum, and the clamor for a synthetic fuels industry *now* has abated somewhat, it is interesting to note that attention continues to be focused in some quarters on the long-term energy situation. The belief is that proper conservation today will have important consequences in later years.

One of the outstanding prophets in this field, in recent years, has been Eugene Ayres of the Gulf Research & Development Co. To his earlier papers on the subject of energy reserves he has now added another, a "Look Ahead at Our Energy Sources and Resources."[1] In it, he states that "the present rate of increase of demand (for energy) appears to be about 50% in 50 years. But in the future, if losses of converting one fuel to another become rapidly more important, the rate of increase of consumption of energy raw materials may be expected to exceed the rate of increase of demand for the energy produced. The next 20 years may see some production of liquid fuels from coal, but this is not likely to be on a substantial scale. . . .

"Assuming that the rate of increase of demand kept up to 50% in 50 years, the demand 100 years from now would be 29.7 trillion horsepower hours instead of the present 13.2. The additions for conversion losses might then be: electric power manufacture, 7; coal conversion to liquid fuels, 9; natural gas conversion to liquid fuels, 1; total, 17; this would bring our total energy requirements up to about 45. This estimate assumes the production of two billion barrels per year of synthetic petroleum from coal, and the existence of another one or two billion barrels of natural petroleum production, either domestic or imported. Our demand, then, will be certainly far above two billion."

In stressing the need for conservation of fossil fuels, Ayres points out that "synthetic motor fuel from coal or gas used to operate a motor car results in an energy system efficiency (product of production, working, and transmission efficiencies) of 2.5 to 5%, putting the system at the very bottom of the list of energy applications. Conversion of coal to liquid can be justified only by a compelling necessity to produce more liquid fuel than can be obtained from other sources. This is in sharp contrast with the conversion of oil shale, which is not usable as a fuel until it is treated to recover its oil. . . . Thus shale oil recovery would constitute an important measure of conservation."

All of this is food for thought and, if possible, action. In the meantime, there is an evident need for increased use of what Ayres terms the "constant sources of energy"—wood, hydroelectric power, solar power, etc.

Incidentally, one mechanism which makes use of a "constant source of energy"—the "heat pump"—is now expected[2] "to play a bigger role in keeping homes comfortable. . . . General Electric is undertaking limited production of them this year. York Corp. will also turn some out. Cost of an installation is about $2,000 for a five-room house. That's two to three times the cost of an oil, gas, or coal furnace. 'But,' pump advocates emphasize, 'you are getting a combination heater and cooler that takes care of you summer and winter.' Operating expense for electricity is called comparable to the cost of fuel for heating with furnaces. Over 500 heat pumps are now in operation. Most are in balmy Florida and Southern California, but they're scattered elsewhere—and makers say they are practical in any clime."

Carbon Black Industry Faces Supply-Demand Difficulties

CARBON black, a product derived from natural gas or petroleum fractions, is a substance which has often faced a shifting economic future. In wartime years, for example, it was in overwhelming demand, and the prewar capacity of the carbon black industry (more than adequate for prewar demands) was rapidly expanded to meet the critical need, amid much publicity and controversy. Since the war, the demands for carbon black have varied, but have never approached wartime peaks.

Now, "carbon black producers have petitioned the National Security Resources Board to have the Munitions Board change the classification of carbon black from that of a 'critical' to a 'strategic' material and to purchase and stockpile carbon black either as such or as GR-S black masterbatch." They point out that "it will be difficult, if not impossible, to secure a sufficient supply of either channel or furnace black for use with rubber in an emergency" because several furnace and channel black plants are shut down because of diversions of natural gas to pipelines on long-term contracts, etc. "Shut-down plants are permanently lost because of corrosion of equipment while out of production. Production estimates for channel black are 579,700,000 lbs. for 1950, compared with 627,369,000 in 1949." Increased production of furnace black would necessitate diversion of natural gas or "the special gas-oil" which is in heavy demand in wartime for Diesel fuel. New pipelines are expected to be "tapping natural gas reserves located near Government channel black plants in the West Texas-New Mexico area, so these plants, two of which have been leased to private operators, cannot be counted upon to produce fully in time of war."

Recognizing these elements of the situation, the NSRB has decided to make a thorough investigation of carbon black production facilities and raw materials.[3]

At present, it is said[4] that carbon black manufacturers fear a permanent shut-down of 20% of their channel black capacity, since they are currently producing 50,000,000 lbs. per month of channel black and selling only 40,000,000 pounds; "they want the Government to buy the rest before production is retrenched to fit the contracting market." Another source[5] reports that "while exports of carbon black are still holding up remarkably well, two new carbon black plants in England—one plant built by Cabot and another using the Phillips process—are expected to satisfy 60 to 75% of English requirements and will come into production in August. Competition for the foreign market is also increasing with the advent of German black made from a naphthenic starting material."

Carl E. Kayser, president of the Columbian Carbon Co., recently told the stockholders of his company that, "at present carbon black prices, there is a strong inducement for the carbon black maker who uses his own natural gas to make his black to cease the manufacturing of this product and sell his gas to such outlets as pipeline companies. 'Where petroleum oils are the only or essential

raw material, the sensitivity of their prices to market conditions is a strong deterrent to building new (carbon-black-making) capacity in the face of present prices of carbon black and construction cost levels.' "(6)

Carbon black is an essential material in the compounding of natural and synthetic rubbers, and an important material in other fields. The present situation is one whose significance cannot be ignored.

New "PB" Synthetic Rubber Is Butadiene Polymer

A COMMERCIALLY satisfactory polybutadiene synthetic rubber, known as "PB" rubber, has been developed for tire treads, according to an announcement from the Phillips Petroleum Co. The new development was worked out by Phillips in research supported by the Office of Rubber Reserve. Phillips does not make rubber but it does produce in the order of 180,000,000 lbs. of furnace carbon black per year, an important ingredient in both GR-S and the new PB synthetic.

The idea of making a synthetic rubber from butadiene-type materials alone is not new. The Germans tried several during World War I, but the products were vastly inferior to today's GR-S, which is a co-polymer of butadiene and styrene. Many attempts have been made since to achieve a satisfactory butadiene polymer, but the results invariably have been materials which were very difficult to process while the quality of the resulting products left much to be desired until the present development.

There have been three principal factors urging research in this direction. The first is a theoretical analogy to the effect that natural rubber is a polymer of isoprene, a material similar to butadiene; therefore a butadiene polymer should approach natural rubber in quality more closely than the butadiene-styrene copolymer. The second is the increasing scarcity of styrene in recent months which has restricted the volume of GR-S synthetic which could be made, even though formulations have been perfected to reduce the amount of styrene normally required. Still another is that styrene always has been more expensive than butadiene.

The most recent impetus to the search for a polybutadiene rubber has been the steadily increasing price of natural rubber, which for a time almost doubled its 16c per lb. price of six months ago, and currently is well above the present 18.5c price of GR-S.

As has been the case with so many important developments in the past, the production of a satisfactory polybutadiene synthetic rubber is simple—when you know how. Phillips' scientists used two well-known procedures in modified form—the "cold rubber" process and so-called "masterbatching" of furnace black with the synthetic latex before coagulation.

Heretofore with GR-S synthetic, it has been desirable to produce the coagulated rubber with a "Mooney Number" (an arbitrary value related to the viscosity of the finished rubber) of around 50 in order to give good handling qualities during production of the rubber and subsequent factory processing. But when polybutadiene was made to this number, it was relatively impossible to compound it later with carbon black and the other additives normally incorporated in the finished material.

The new procedure calls for a modified formulation during polymerization to produce a "softer" product having a Mooney value in the vicinity of 20 to 30. A reaction temperature of 86° F. is employed, compared to the "cold rubber" polymerization temperature of 41° F. and the normal process temperature of 122° F. used for conventional "hot" rubber. Before coagulation, the latex is masterbatched with the required quantity of high abrasion furnace carbon black to give the required properties during drying and finishing. Masterbatching is frequently done with synthetic rubbers.

It is too early yet to properly evaluate this new polybutadiene rubber. However, on the basis of early tire tests (and this is reportedly one of the first times a polybutadiene rubber ever was considered worth road testing), the new product appears to be at least equal in quality to "cold rubber" for tire treads. Production for use in manufacturing thousands of tires for further proving on highways has been scheduled by Rubber Reserve.

Plant Costs May Slow Growth Of Plastics from Petroleum

IN a recent article(7) on "Plastics and Organic Chemicals," John M. Weiss has stated that "the trend of (increased) production of synthetic plastics represents the largest present single factor in determining the general growth of the organic chemical industry," especially when considered in conjunction with the production of those synthetic fibers allied to plastics. According to Weiss, it appears evident that "synthetic plastics, taken as a whole, have by no means reached their production peak and that total tonnage may be expected to continue increasing at a rapid rate. . . .

"A serious problem in the development will be the raw material supply, and especially the capital investment necessary to make such raw materials available. It appears obvious that a large part of the future plastics will be based on petroleum and natural gas, . . . so that raw material, *per se*, is not a controlling factor. The capital requirements are more serious. Were synthetic plastics use to treble in the next seven years, as it has in the past seven years, the new money to be invested in the chemical and plastics industry may be estimated as something in excess of $1,500,000,000. . . . Synthetic fibers can conceivably make a similar demand on chemical producing facilities."

As regards the synthetic fibers, recent developments indicate an extensive trend toward increased use, especially of new entries into this field. Orlon, "one of the top textile developments of the past ten years," will enter the market commercially in August, but the 6,500,000 lbs. which du Pont will produce at its Camden, S. C., plant will apparently fall far short of market demand. The various synthetic fibers are said to be competing strongly in the suiting materials field, especially rayon, Vicara blends, Orlon, and Dynel. Rayon, meanwhile, is taking over more of the tire-cord market because its quality is better than cotton for tire-cord manufacture and because its price, being without Government support, is cheaper. Even more tire-cord rayon would be used if the suitable grade were available.

Rug manufacturers are also paying close attention to the synthetic fibers, because of recent increases in the price of the grade of wool used in carpet making. While synthetics such as rayon and nylon have long been mixed with wool in making a few rugs, manufacturers are said to be looking for new synthetics—"better-wearing than rayon, cheaper than nylon. Every rug maker is working with chemical companies to produce them."(8) Representatives of the dye industry, however, have pointed out that each new synthetic fiber presents new finishing problems.

While petroleum hydrocarbons are by no means the only raw materials for these new synthetic fibers, and for increased production of plastics, they seem destined to play a dominant role in future developments.

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(5) Anon., "Black Repercussions," *Chemical and Engineering News*, 28, No. 18, 1447 (1950).
(6) Anon., *Wall Street Journal*, May 15, 1950, p. 15.
(7) John M. Weiss, "Plastics and Organic Chemicals," *Chemical and Engineering News*, 28, No. 19, 1554-56 (1950).
(8) Anon., *Wall Street Journal*, May 11, 1950, p. 1.

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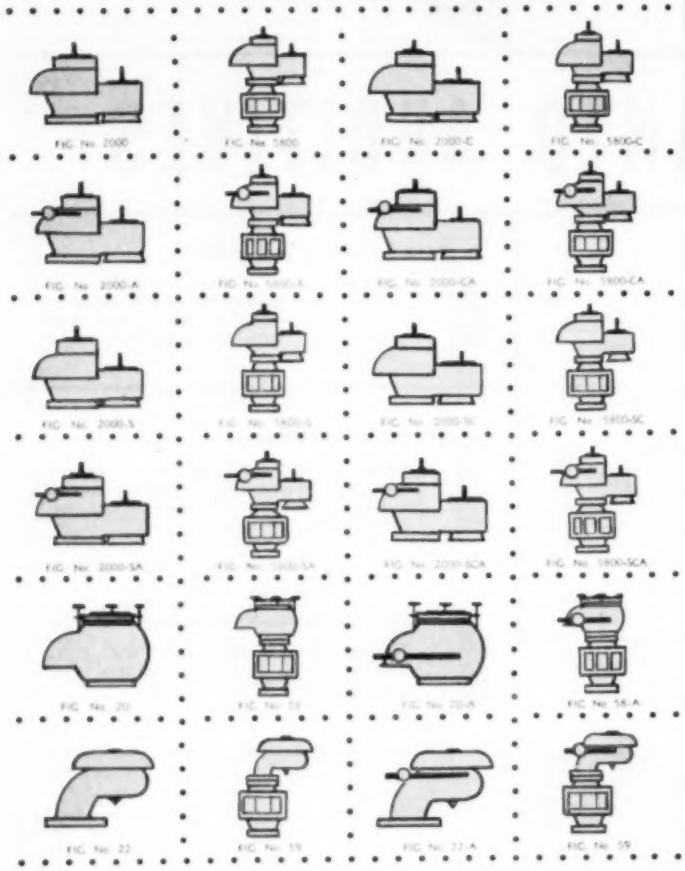

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Letters . . .

War Preparedness

I have read Herb Yocom's article "Refiners Are Keyed into Oil's War Preparedness Program" (June PP, p. 606) with a great deal of interest. I think the story is well told as far as security restrictions will permit, and I believe that such an article can be of real value to the country, not particularly because of the recognition given to the industry representatives . . . but because I believe it could be of real national value if the industry as a whole knows of the cooperative work now under way.

Another war, if it comes, might quite possibly burst on us overnight with extensive bombing raids and well-planned sabotage—another Pearl Harbor but ten thousand times worse. Under such conditions, confusion and chaos must reign for some period of time. It is in this period when civilians, already trained in the military needs for petroleum, could be of inestimable value. These civilians trained in the Military Petroleum Advisory Board could and, I believe, would serve as guides to coordinate the activities of the industry, although possibly without legal status at the time, and I believe that under such conditions the industry would gladly accept such guidance.

A. P. FRAME
President
Cities Service Research
and Development Co.
New York, N. Y.

• The article . . . in general clearly explains the existing situation. However, for the accuracy of the record . . . a word about the wartime functions of the Military Petroleum Advisory Board is considered appropriate. It is our understanding that, regardless of the role each individual associated with that Board may take during a future war, the Board itself, and its district committees, as such have no post-D-Day functions.

Undoubtedly some of the individuals presently involved in Military Petroleum Advisory Board work will be "tapped" by the wartime civilian petroleum agency. It is, however, probable that the Board itself will cease to exist as an entity when war starts.

BURTON B. BIGGS
Rear Admiral, U. S. Navy
Executive Secretary
Petroleum Committee
Munitions Board
Washington, D. C.

• I was pleased to see PETROLEUM PROCESSING give this space to the work of the Military Petroleum Ad-

visory Board, which I think it quite important in the interest of the nation . . . Mr. Yocom treated the subject quite adequately but there is one point called to mind that deserves some amplification. Table 1 of the article is entitled "Military Petroleum Advisory Board Personnel." That title is not an accurate one because 206 members of the petroleum industry who are serving on the various MPAB committees were not mentioned. I doubt that it would have been feasible or desirable to include so many names in the table, but it could have been better captioned "Headquarters Personnel of the Military Petroleum Advisory Board and Chairmen of Committees Operating under MPAB's Jurisdiction."

BRUCE K. BROWN
President
Pan-Am Southern Corp.
New Orleans, La.

"Teepol"

We notice in the March 1950 issue of PETROLEUM PROCESSING, pg. 219 ["Synthetic Detergents Gain Despite Soap's Competition"] . . . that you include the statement "Paralleling that, England multiplied her production of alkyl aryl sulfonates and at the same time increased the secondary alcohol sulfates derived from paraffin—the Teepols".

We would draw to your attention that "Teepol" is a United States Registered trade mark of our associate Shell Chemical Corp. and would appreciate your using it as a trade mark rather than in a generic sense as above.

H. D. BIRCH
Shell Development Co.
San Francisco

Referee vs. Regulator

In the face of present trends and the difficulties other states are having, it would seem that Senate Resolution No. 65 recently adopted by the Special Session of the 51st Legislature of Texas would have particular significance to the state and the petroleum industry as a whole.

This resolution requested that the Governor of Texas "appoint an Industry Advisory Committee composed of representative persons from each segment of the petroleum industry . . . to furnish technical information in an advisory capacity only to the Texas Legislative Council."

The Petroleum problems of Texas are the petroleum problems of the entire industry and this resolution is an overt attempt on the part of the governor to have Texas industry iron out its own problems and to do so before these reach such proportions as might provoke a demand for Federal solution. The formation of this committee affords a medium—not dependent on other groups or departments—through which represen-

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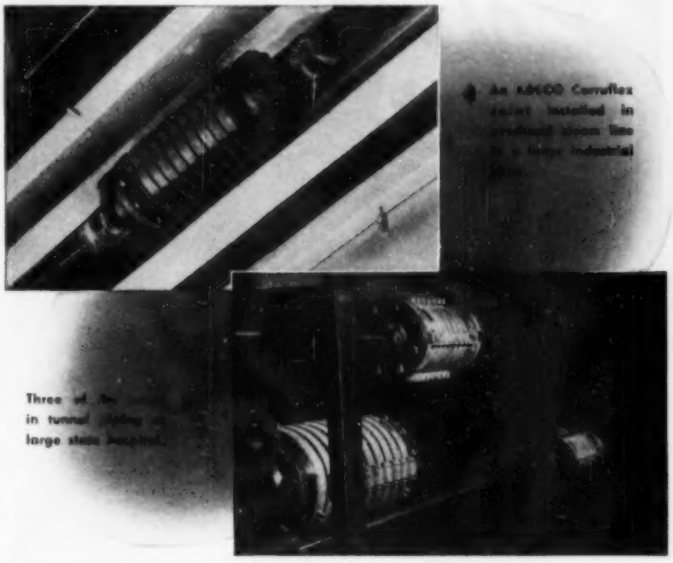

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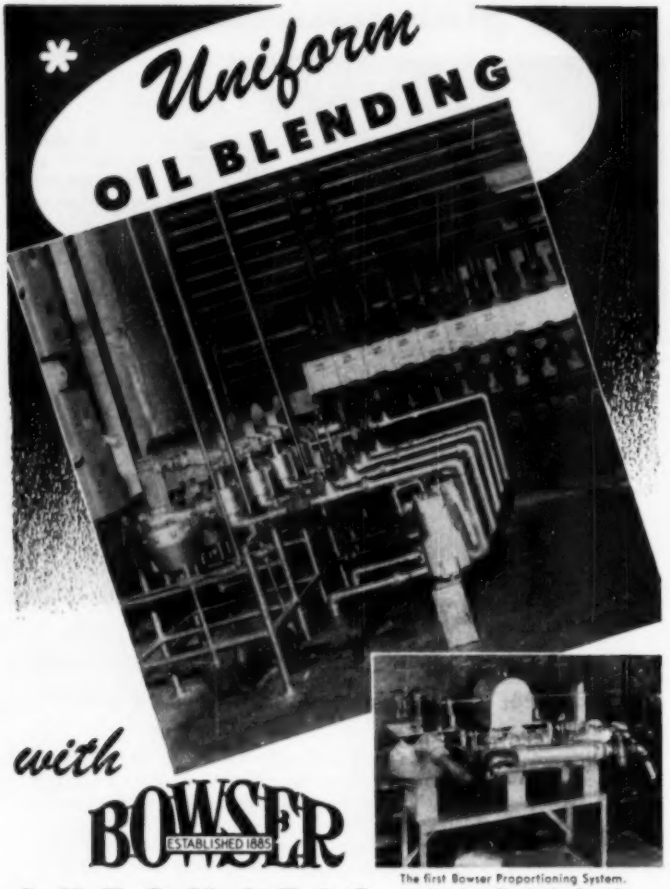

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tatives of all levels of industry might meet on common ground and tell their story.

The possible benefits to the entire industry through the formation of this Industry Advisory Committee are too numerous to mention. I feel, however, that the foremost significance is that precedent which allows all levels of industry the opportunity to arrive at a solution to their problems with the aid of a referee and not a regulator.

J. W. JACKSON
Independent Refiners Assn. of America
Houston, Texas

Gravity Correction

We would like to obtain a copy of an API Gravity Correction Chart that has an indicated gravity range of 0.1 to 20.0 and a temperature range of 196° to 300° F. Can you tell us where we might be able to secure such a chart?

G. P. HIBLER
Chief Chemist
Phillips Petroleum Co.
Woods Cross, Utah

The Division on Measurement and sampling of ASTM's Committee D-2 is now compiling an extensive set of oil measurement tables. One of these will cover the reduction of observed API gravity to API gravity at 60° F. for the range of 0-29° API and up to a temperature of 250° F. These new tables are not expected to be published until next year, however.

Statistics

I have studied in detail your statistical presentation on natural gas liquids data ["Refining Trends", Figs. 8, 9], and believe some improvements could be made by including more complete information. For instance, the production of lease condensate (which is a natural gas liquid) is not shown on your charts. This amounted to about 21 million barrels for the year of 1949 and is currently about 65 thousand barrels per day.

Refinery products supply a sizable portion of the LPG market. As a partial offset to this, refineries use a certain amount of natural propane-butane mixtures as raw material. In 1949, 23.1 million barrels of refinery products moved to LPG markets and refineries purchased from the natural gasoline industry 11 million barrels of C_3-C_4 raw materials. If these figures could be worked into your graph on LPG's and an over-all total LPG demand figure set up, I believe you would have a worthwhile improvement. As it is now, your "Liquefied Petroleum Gas Demand" must represent only the demand from natural gasoline plants.

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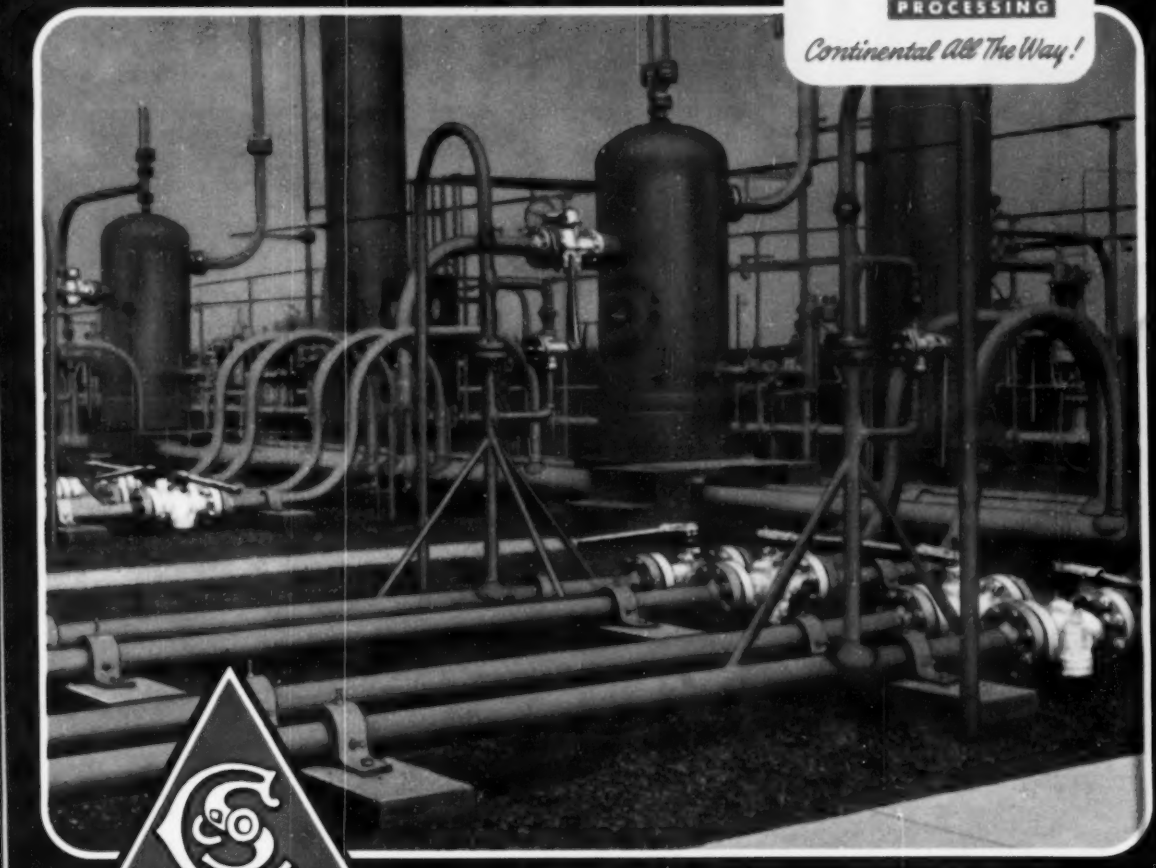

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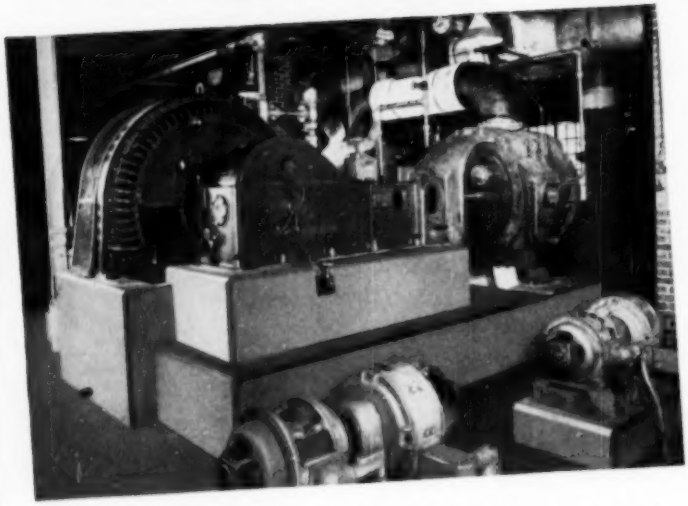

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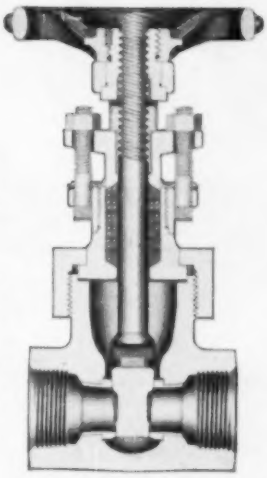

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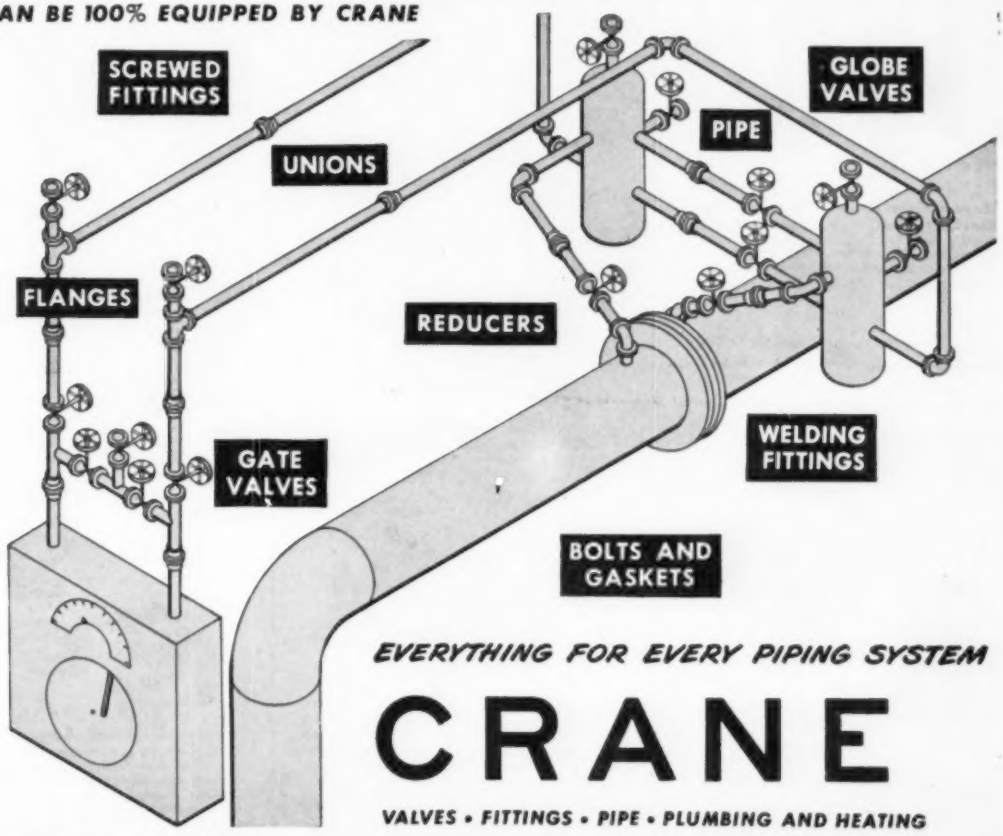


EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

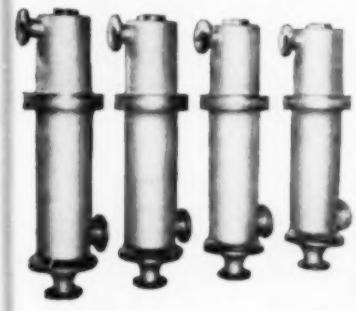
VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

[To obtain more data on advertised products see page 762]

Pipe Fittings — Ampco pipe fittings are available in all sizes . . . ells, tees, crosses, reducing fittings and flanges . . . forged, wrought, fabricated or cast — with flanged, welding or screwed ends . . . schedule 10 through schedule 160.

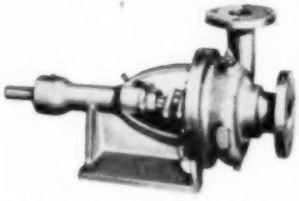
Process Pipe . . . Prefabricated Ampco alloys selected for resistance to corrosive action of waste liquors. Prefabricated at Milwaukee from centrifugally cast sections, including flanges. Ampco pipe is also available in extruded seamless IPS up to 4" and in larger diameters welded automatically from Grade 8 plate.

Conveyors . . . Sulphuric Acid Service — Ampco alloys selected for top resistance to erosion, corrosion and abrasion for conveyors handling bulk materials saturated with 10% H_2SO_4 at 210° F. Entire assembly — flights, troughs, shafts, buckets, chain, bearings, etc.—fabricated from Ampco alloys with matching Ampco-Trode electrodes.

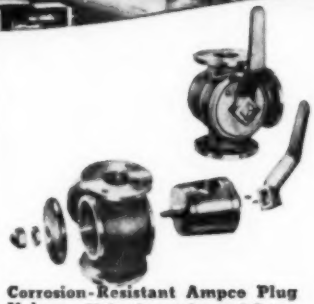


Barometric Condensers and Jet Ejectors — Ampco alloys selected for high strength, corrosion resistance and ability to withstand high-velocity impingement. Sand-cast venturi welded with Ampco-Trode to centrifugally cast body.

Heat Exchangers — Shown above are typical Ampco fabricated exchanger heads. Complete exchangers including tube sheets, tubing, heads and shells made from corrosion-resistant Ampco alloys are available through the fabricator of your choice.

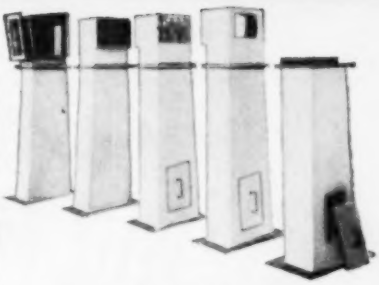


Ampco Centrifugal Pumps — Here — for the first time in pump manufacturing history — is a "production-built" and "production-priced" pump to handle acids, salts, alkalies, and other corrosive agents hitherto requiring specially built pumps. The Ampco single stage, single suction centrifugal pump offers long life, high efficiency and low maintenance costs through the combination of correct design and properly selected materials.



Corrosion-Resistant Ampco Plug Valves — Made of properly mated Ampco alloys to combine operating efficiency with extremely long life—under the most severe conditions of corrosion, erosion, cavitation, and abrasion. No pockets to trap corrosive liquid. Available from $\frac{1}{2}$ inch up to any desired pressure, in straight-through (2-way) or 3-way, lubricated or non-lubricated types.

Fractionating Tower...Acetic Acid — Ampco alloys selected for resistance to corrosion by acetic and formic acids . . . and for maximum retention of physicals at temperatures up to 500° F. Fabricated of corrosion-resistant Ampco alloys throughout . . . deep-drawn sheet, plate, extruded tubing, centrifugal castings, etc. . . . welded with Ampco-Trode 160 electrodes.



Chutes . . . Potash Production — Ampco alloys selected to resist the severe erosive and corrosive effects of the mixture being carried. Fabricated of ¼" thick corrosion-resistant Ampco 8 plate welded with Ampco-Trode 160 electrodes. No pre-heating or post-heating was required. The weld joints match the parent-metal in chemical and physical properties.

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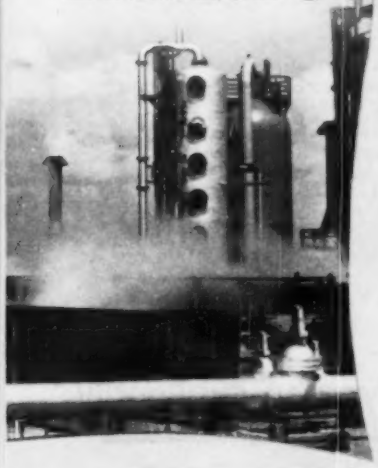
Resist Corrosion, Reduce Costs



...with this unique combination of money-saving properties:

1. High resistance to corrosion
2. High tensile strength
3. High physicals at extreme temperatures
4. High weight to strength ratio
5. High impact and fatigue values
6. High wear-resistance — to erosion — corrosion, cavitation, etc.
7. High compressive strength
8. High modulus of elasticity

The long service life of Ampco Bronze Alloys — at a moderate initial cost — offers unusual savings to both designers and plant engineers.

Reduced material failures mean (a) minimum down-time (b) less production loss and (c) lower maintenance costs.

Increase efficiency of design and operation . . . specify Ampco Bronze alloys for handling corrosive and erosive media. Write today for recommendation and complete information.

Ampco aluminum bronzes are available in a number of grades to meet your exact requirements in any form you need: rolled sheet or plate, sand or centrifugal castings, forgings or extrusions . . . pipe and fittings. Also, Ampco's arc-welding electrodes, corrosion-resistant centrifugal pumps and plug valves.

Free . . .
Process Industries Bulletin — 16 pages of money-saving information.

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One reason is . . . they need no standardizing!

Your instrument men know that product quality suffers when measurement drifts between manual standardizing adjustments. They know, too, that even automatic standardizing allows accuracy to be lost when batteries discharge without being noticed. And if the process is on automatic control, standardizing of either kind "bumps" the process periodically.

You can eliminate these inaccuracies and inconveniences by putting Foxboro Dynalog Electronic Instruments on the job. They require no standardizing, use no batteries. The balancing system has only six moving parts, none moving faster than the pen. Mechanical complications are eliminated, maintenance reduced to the vanishing point.

No standardizing is only one of many important advantages of Dynalog Instruments. Their unique design brings laboratory-standard performance to the measurement and control of temperature (with resistance bulbs or thermocouples), humidity, pressure, flow, force, pH, conductivity, etc. Their speed . . . full scale to new balance in as little as one second. Sensitivity . . . one ten-thousandth of scale. Accuracy . . . ¼ of 1% of scale.

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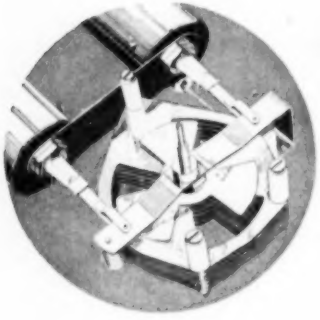

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The electronic potentiometer that has NO SLIDEWIRE

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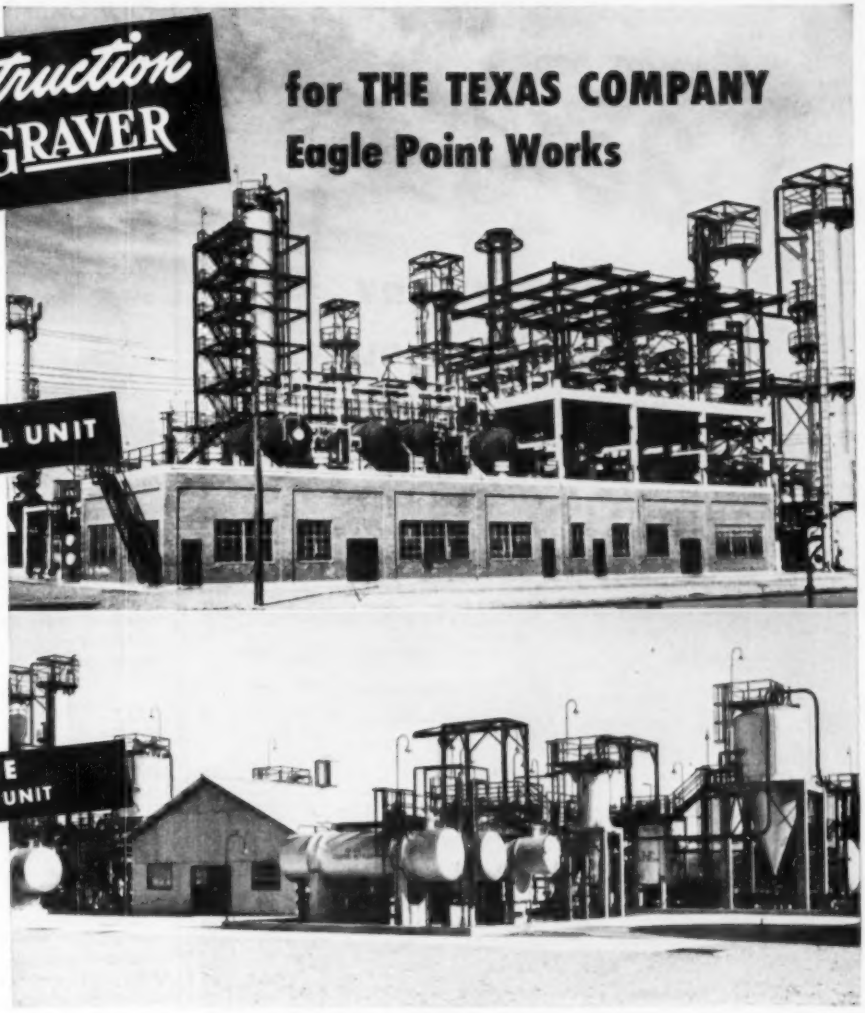

Again it's *construction by Graver* . . . this time, The Texas Company's first large east coast refinery—the multi-million dollar Eagle Point Works at Westville, New Jersey.

The Furfural Unit is a special design developed by The Texas Company and erected by the Graver Construction Co. This unit efficiently removes sulphur from middle distillates which are processed into diesel fuel and heating oil. The Linde Treating Unit was designed and erected by Graver from a flow sheet.

Other Graver construction included five cooling tower basins and pump houses, propane control house, B.S.W. pump house, river pump house, barometric oil separator basin and such miscellaneous jobs as foundations, pipe supports, sewers, manholes, and the handling of all material.

For further information and details . . . get in touch with Graver today. *When it comes to construction . . . come to Graver!*

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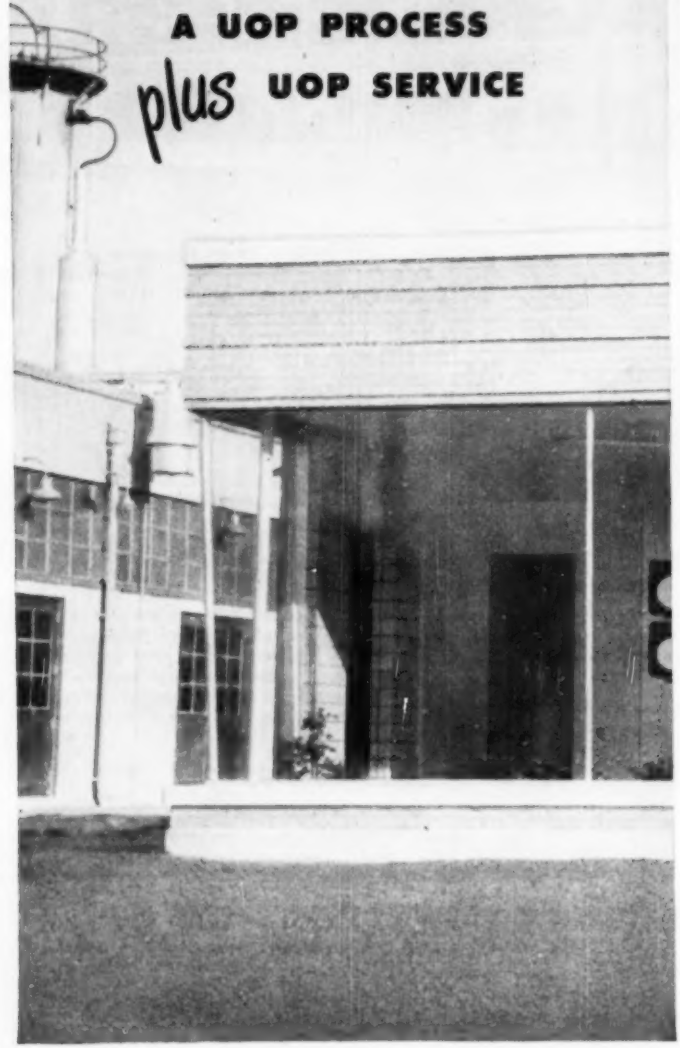


New Cosden Cat Cracker Runs West Texas Gas Oil

By R. L. Tollett

President,
Cosden Petroleum Corporation

THE FIRST fluid catalytic cracking unit ever built to operate exclusively on gas oil from West Texas crudes went on stream at our Big Spring, Texas, refinery in November of last year and is now producing 2,600 to 2,800 b/d of gasoline.

R. L. Tollett

The unit was originally designed on the basis of a 6,000 b/d charge rate and a 50 percent conversion to produce 2,460 b/d of gasoline. In actual operation, however, the charge rate was decreased to about 5,200 b/d and the conversion increased to about 65 percent.

The following table, covering a recent week's run, shows the actual yield of the various products compared with the design figures:

	Design	Actual	Actual Vol. %
Raw oil charged	6000	5187	100
Gasoline	2160	2627	50.7
Light cycle stock	1950	1427	27.5
Heavy cycle stock	1050	249	4.8
Slurry oil		123	2.4
Conversion %	50	65.3	

During a typical 24-hour run, the results were as follows:

	Barrels c/d	Vol. %
Raw oil charged	5170	100
Gasoline (10.5 R v.p.)	2810	54.5
Light cycle stock	1450	28.1
Heavy cycle stock	280	5.45
Slurry oil	200	3.85

Modernization Program

The new cat cracker is the heart of an improvement program planned late in 1948. Our objective was to modernize our facilities to produce a gasoline that would meet the requirements of the high compression engines of today and of the future. Consultation with Universal Oil Products enabled us to set up a four point program of modernization which included these steps:

1) Installation of a vacuum distillation unit.

2) Installation of a gas concentration unit consisting of a new gas absorption system and adaptation of existing stabilizer to new service.

3) Revamping and enlarging of the existing catalytic polymerization unit.

4) Installation of the cat cracker.

(Advertisement)

[To obtain more data on advertised products see page 762]

The first three steps were necessary to supply feed to the projected cat cracker, designed to crack 6,000 b/d, and to handle its products. Design and engineering of the entire program was entrusted to Universal Oil Products Company and the cat cracker is built to UOP's improved fluid design.

Run 17,500 b/d

The refinery is presently running about 17,500 b/d of crude from the Howard-Glasscock, East Howard and Benedum fields.

Because of the average high sulfur content of these crudes, the vacuum tower is completely alloy-lined and the furnace tubes are chrome alloy. It was designed to handle 7,300 barrels of reduced crude of 22° API gravity and existing equipment was used as far as possible in the new construction.

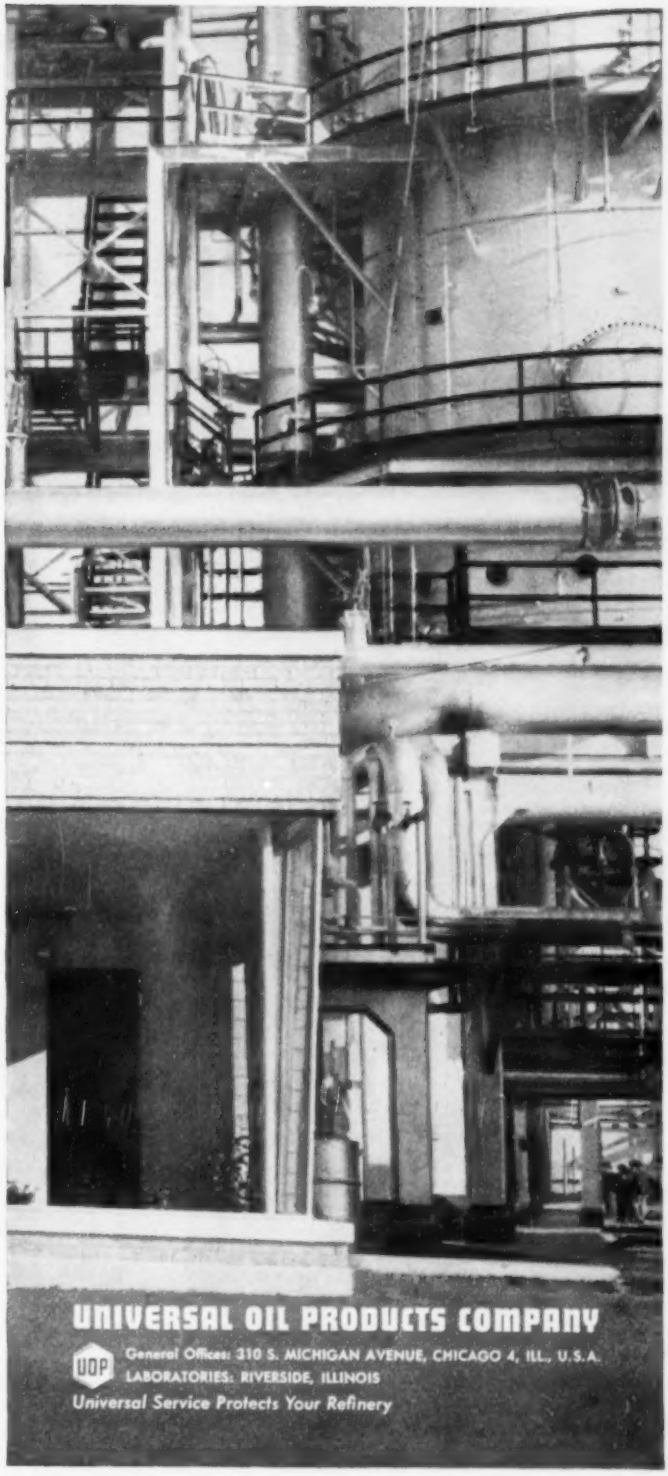
Reduced crude is taken directly from the crude still and pumped through the vacuum unit heater into the vacuum unit fractionating column. About 5,400 barrels of 28° API gravity vacuum gas oil are taken overhead from the tower while about 2,200 barrels of asphalt are withdrawn from the bottom of the tower. This asphalt is blown and blended for the manufacture of specification road oils and asphalts, roofing asphalts and commercial asphalt fluxes of various types.

The gas concentration system consists of low and intermediate pressure receivers, compressors, absorbers, stabilizer and deethanizer.

Gases from the cat cracker are compressed in two stages to about 200 pounds pressure per square inch. They pass through the primary absorber where they are contacted with O.H. receiver liquid, and then into the sponge absorber. Sponge oil is light cycle stock which is returned to the main fractionator for stripping. Primary absorber bottoms go to the stabilizer. Overhead from the stabilizer joins with a similar stream from the thermal cracking debutanizer and the mixture passes into the deethanizer, which was designed to remove the major part of the H_2S as well as the ethane from the C_3 and C_4 hydrocarbons which are withdrawn from the bottom of the deethanizer as feed for the poly unit. Up to 90 percent of the H_2S is removed from this stream by the deethanizer. Deethanizer bottoms contain 150 to 160 gr. H_2S per 100 SCF.

The C_3 and C_4 fractions pass through a caustic and a water wash on their way to the poly unit. The caustic treatment removes the remaining H_2S and the water takes out the nitrogen compounds.

The poly unit is daily processing approximately 1,100 barrels of feed, yielding about 410 barrels of polymer gasoline having a Research octane number of 97 clear.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[To obtain more data on advertised products see page 762]

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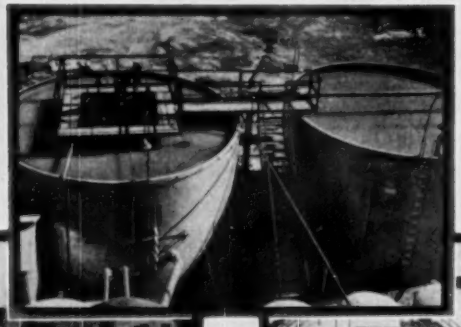
For the Clarification of Water and the Recovery of Waste in Process

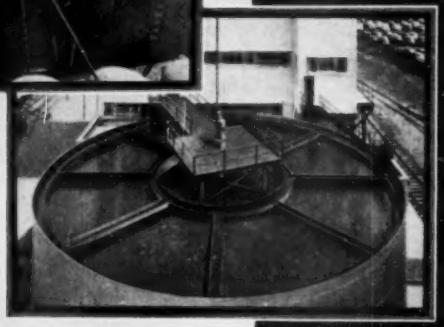
Clarifies water by use of sludge contact principle.

Raw water and chemicals enter near the bottom of the tank. Motor driven agitator mixes them thoroughly forming floc or precipitate. The agitator also keeps the floc or sludge suspended, so that the water is both treated and filtered by the sludge bed or blanket as it rises in the tank.

COCHRANE's specialization in the conditioning of industrial water supplies over the past fifty years and the combined years of experience of Cochrane engineers in that field, is your assurance of satisfactory service from any Cochrane installation. In the new method of sludge contact or removal by flocculation of impurities, turbidity, color or hardness, the Cochrane Sludge Contact Reactor accomplishes all these functions with complete efficiency and surprising economy. A new bulletin, Publication 5001, is available and will be sent on request.

The inclined blades of the agitator cause water and sludge to be deflected to the center where the mixture rises through the central port and is then recirculated back to the bottom, saving chemicals and producing a heavier floc. Central steel baffles divide the Reactor into a mixing zone at the bottom and a clarifying zone at the top.





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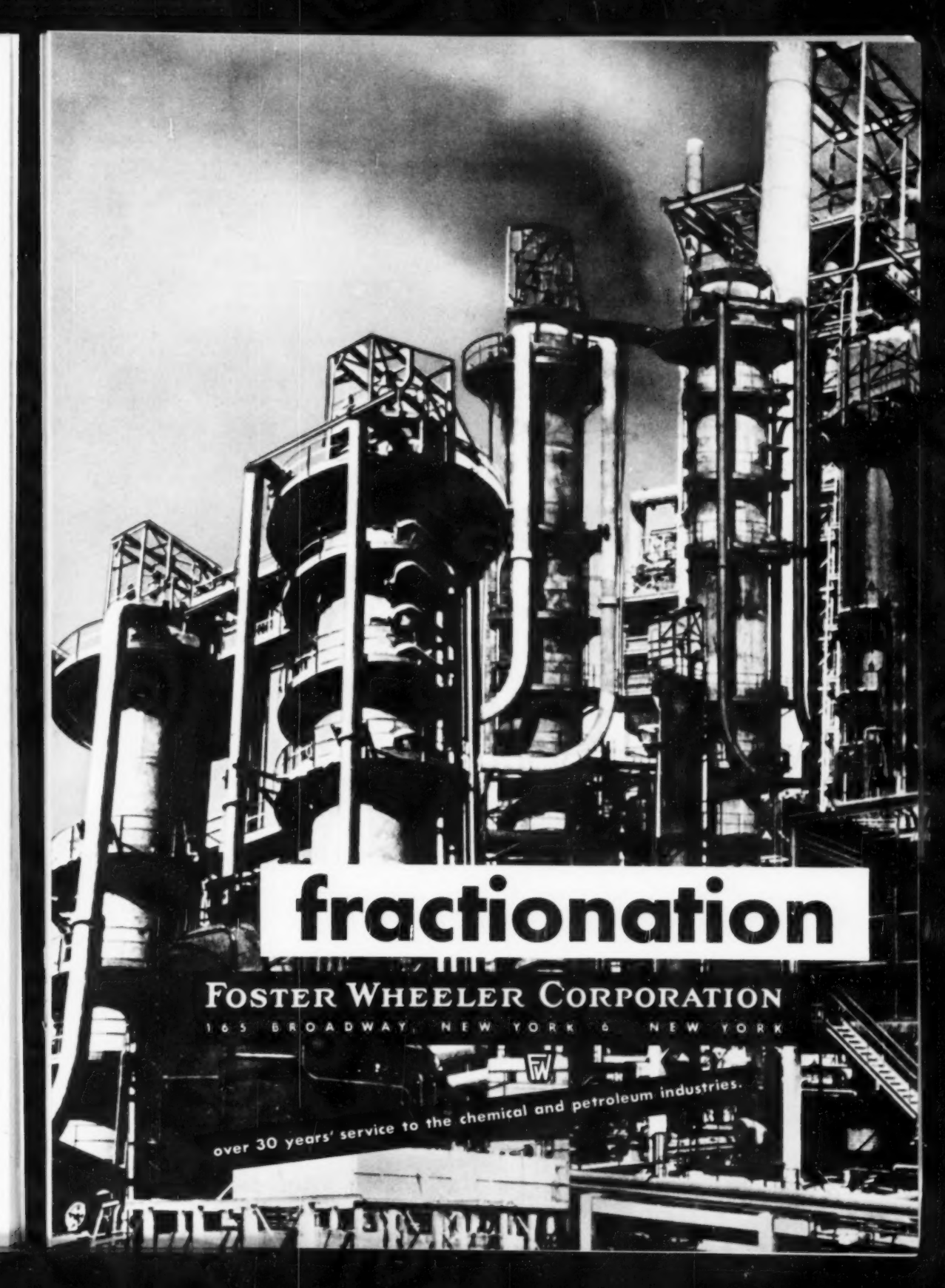
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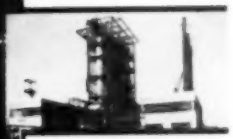

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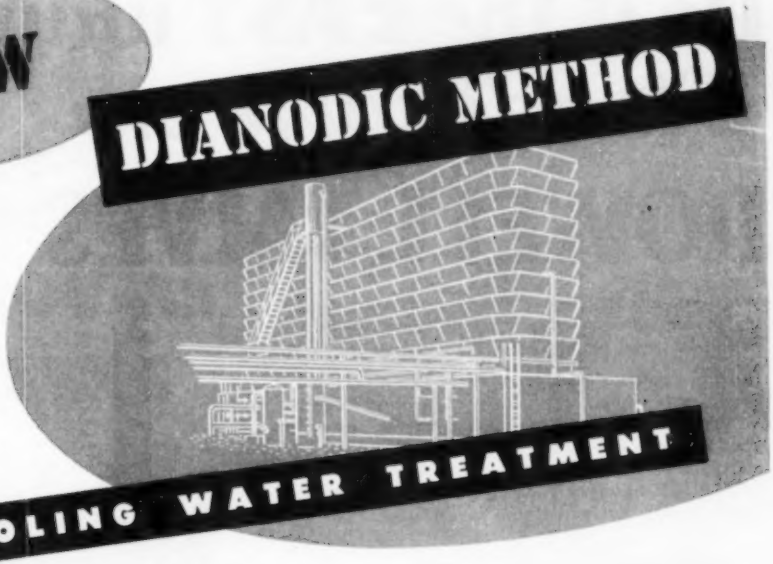
NEW DIANODIC METHOD OF COOLING WATER TREATMENT



Here's an entirely new approach for the prevention of corrosion, pitting and scale in cooling water systems. The dianodic method was developed in the research laboratory and proved in the field. Amazing results are obtainable—Freedom from Scale, Protection against Corrosion, and ELIMINATION OF PITTING AND TUBERCULATION.

Basically, the dianodic method consists in employing a combination of two anodic inhibitors in such a manner as to produce results superior to either inhibitor singly—*even in high concentrations.* With the proper use of conventional inhibitors it is possible to obtain good overall corrosion protection, but localized corrosion may continue to occur in the form of pitting. In these areas of concentrated attack, corrosion may be accelerated so that metal failure is almost as rapid as without any corrosion inhibitor. The new dianodic method gives equal or better protection from the standpoint of general corrosion and ELIMINATES PITTING AND TUBERCULATION.

W. H. & L. D. BETZ, Gillingham & Worth Sts., Philadelphia 24, Pa.
In Canada: BETZ Laboratories, Limited, Montreal 1.

A complete report on the Dianodic Method of cooling water treatment. Ask for Technical Paper No. 120.

Here are results that water treatment engineers have sought for years. May we send you complete technical data? No obligation, of course.

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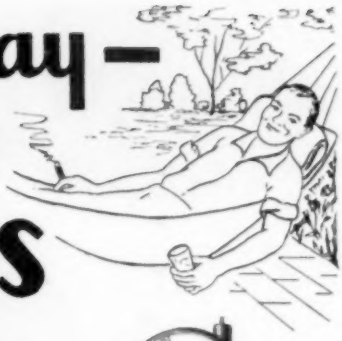
Do it the EASY way—
Standardize on
POWELL VALVES



When you get your valves from various sources, buying for replacement—and stocking spare valves and parts—becomes unnecessarily complicated.

But when you buy **ALL** your valves—Bronze, Iron, or Steel, and, if you need them, Corrosion-Resisting Valves—from **ONE** source, you have the answer to your flow control problems. Powell makes them all* and makes them better. Also Powell makes the *only* **COMPLETE** Line of Valves for Corrosion-Resistance available to Industry today.

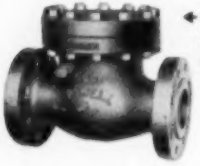


Fig. 6061—Class 600-pound Cast Steel Swing Check Valve with flanged ends and bolted cap. Disc has ample lift to permit full, straightway, unobstructed flow through valve body.

Fig. 1375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze seat rings and disc.

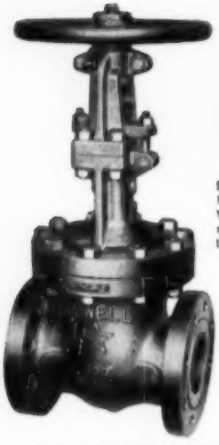


Fig. 3003—Class 300-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 1460—Iron Body Bronze Mounted "Master Pilot" Gate Valve with screwed ends, rising stem, bolted flanged bonnet and tapered solid wedge.

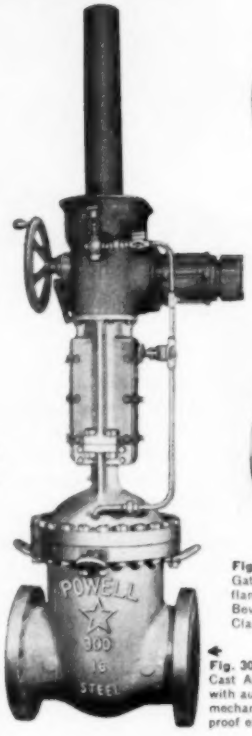


Fig. 3023—Class 300-pound Cast Alloy Steel Gate Valve with automatic steam sealing mechanism. Has explosion proof electric motor operator.

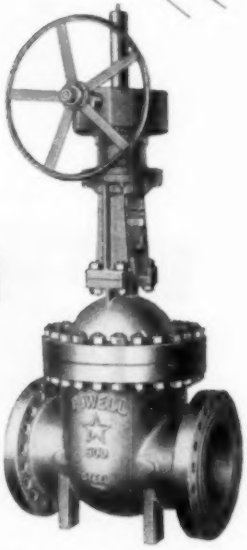


Fig. 6079—Class 600-pound Cast Steel Gate Valve for Pipe Line Service. Has flanged ends and bolted flanged bonnet. Bevel gear operated. Also available in Classes 150, 300, and 400 pounds.

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Here is a bulletin that should be read by every plant executive and engineer with boiler feed problems.

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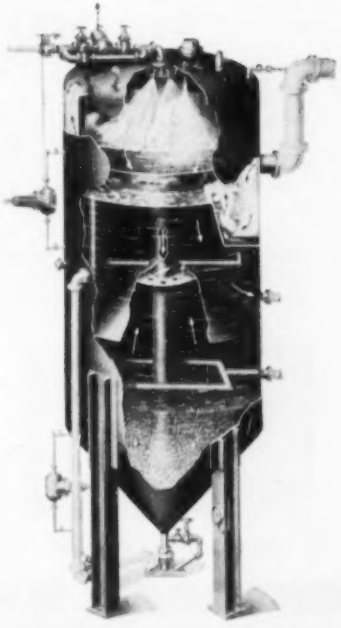
It is *informative* because it clearly shows the practical applications of the scientific principles involved in modern, efficient hot process softener designs.

Copies of the bulletin will be sent without charge to plant executives and engineers writing on their Company letterhead.



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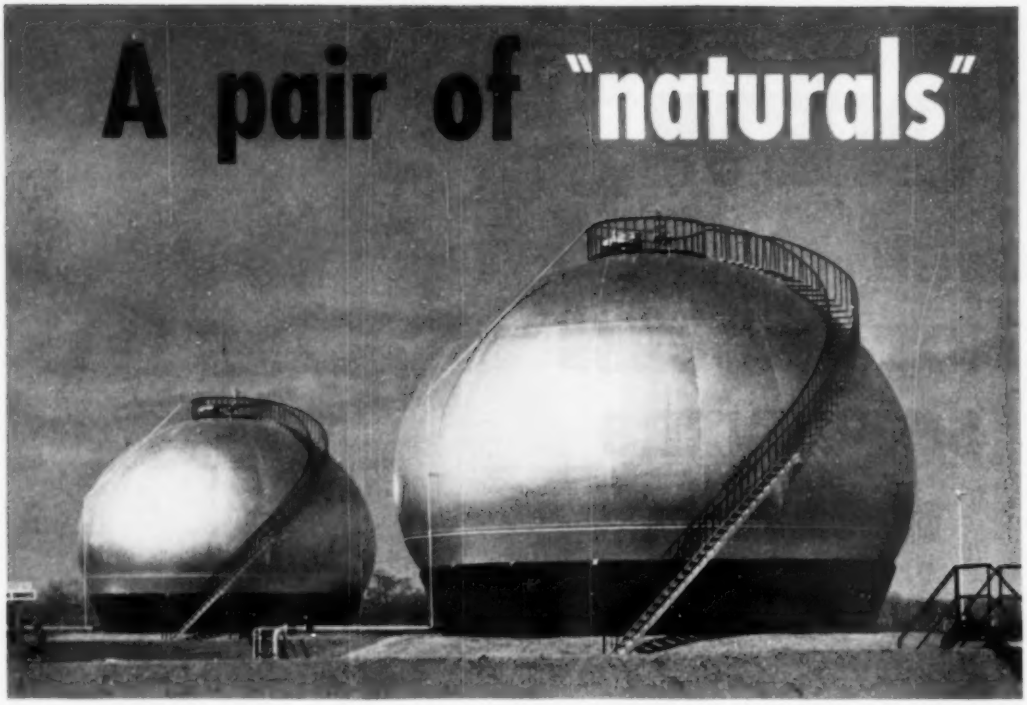
A DIVISION OF GRAVER TANK & MFG. CO. INC. EAST CHICAGO, IND.

A pair of "naturals"



Hortonspheroids and natural gasoline

Everything about the Hortonspheroid—its shape, its working principle, its operation—bears a direct relation to the problem of storing volatile hydrocarbons. That's why it is such a "natural" for handling natural gasoline.

A drop of mercury resting on a flat surface illustrates the ideal shape for a vessel full of a liquid under pressure. The spheroidal form is natural because the stresses created in the shell by internal pressure and liquid load are minimum, being equal in all directions. The strength of the steel in the spheroid is used to best advantage in resisting these stresses. A minimum of material is required to maintain form. Note the similarity in shape between a drop of mercury and the two *plain* Hortonspheroids shown in the above view at a natural gasoline plant.

Noded Hortonspheroid

The working principle of the Hortonspheroid is easy to understand. Built to withstand internal pressure, its method of operation is based on the fact that no loss can occur unless vapor escapes. The pressure in the space above the liquid varies to accommodate changes in the vapor pressure and the partial pressure of the air in the air-vapor mixture. Vapor loss occurs only if the internal pressure exceeds the relief valve setting.

Plain Hortonspheroids are built in capacities from 2,000 to 40,000 bbls. By using the same general design principles and providing internal framing and ties, *noded* Hortonspheroids are built in capacities as large as 120,000 bbls. without excessive height and resultant soil overloading.

When you're storing or handling natural gasoline, reduce your evaporation losses with the Hortonspheroid. For full details, write for a copy of Bulletin E.

Above: Two 10,000-bbl. Hortonspheroids which store natural gasoline at a Sun Oil Company plant in Starr County, Texas.

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta 3 ..... 2103 Healey Building
Birmingham 1 ..... 1927 North Fiftieth Street
Boston 10 ..... 1029–201 Devonshire Street
Chicago 4 ..... 2114 McCormick Building
Cleveland 15 ..... 2215 Guildhall Building
Detroit 26 ..... 1532 Lafayette Building
Houston 2 ..... 2130 National Standard Building
Havana ..... 402 Abreu Building
Los Angeles 17 ..... 1526 General Petroleum Building
New York 6 ..... 3310-165 Broadway Building
Philadelphia 3 ..... 1630–1700 Walnut St. Building
Salt Lake City 4 ..... 530 West 17th South Street
San Francisco 4 ..... 1539–200 Bush Street
Seattle 1 ..... 1330 Henry Building
Tulsa 3 ..... 1620 Hunt Building

REPRESENTATIVES AND LICENSEES

Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
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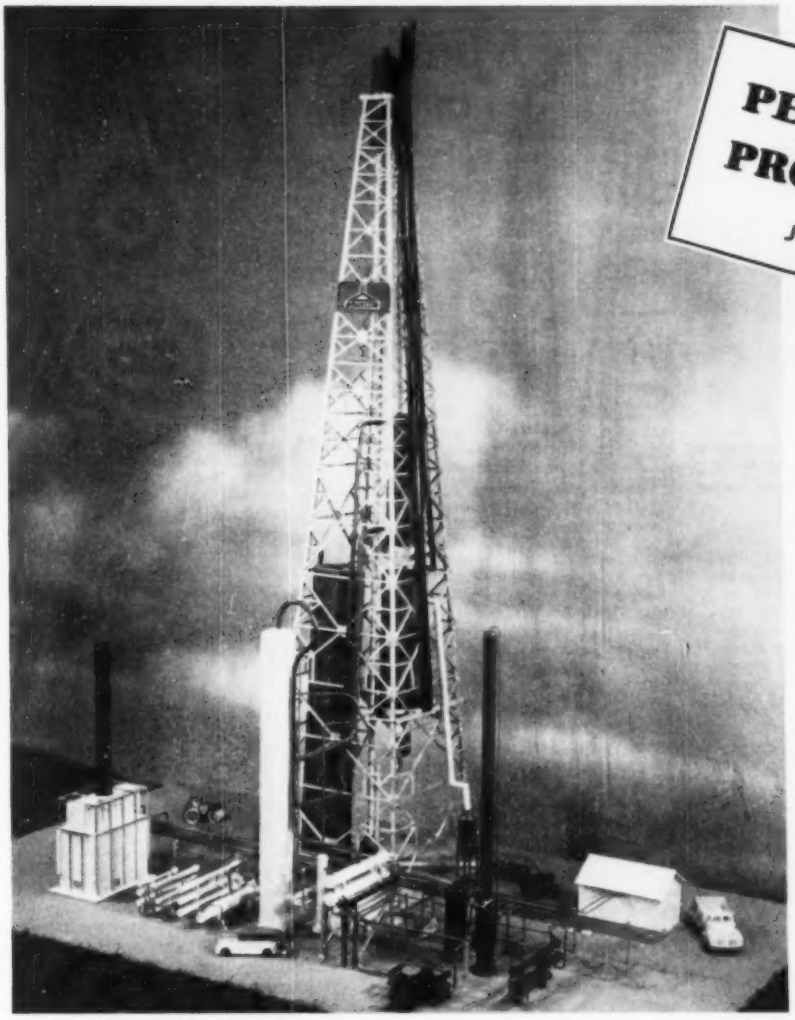
Chicago Bridge & Iron Company, Ltd., Apartado 1348 Caracas, Venezuela
Compagnia Tecnica Industrie Petroli, Rome, Italy
Whessoe Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Comprimo N. V., Amsterdam-O, Netherlands

PETROLEUM PROCESSING
JULY, 1950



AN OIL FIELD DERRICK serves both as erection rig and main supporting structure for the new packaged TCC units which Southwestern Engineering and Socony-Vacuum Oil Co. announced last month. This scale model shows the smaller of the two "packages" being offered

Prefabricated Catalytic Cracking Units Now Available in 'Packaged' Form

By WILLIAM F. BLAND
Engineering Editor

THERMOFOR catalytic cracking units are now being made available in "packaged" form—completely shop fabricated and ready for erection at the refinery.

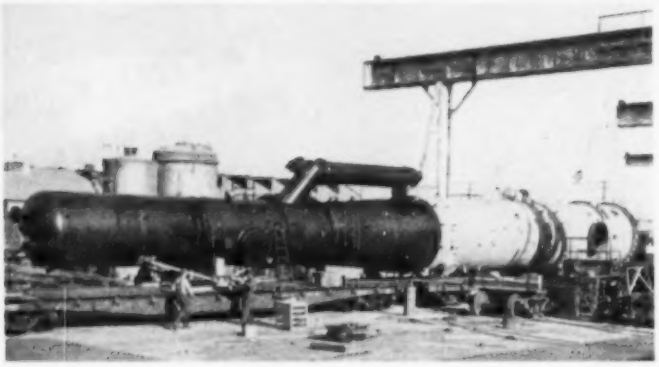
Southwestern Engineering Co. of Los Angeles has joined forces with Socony-Vacuum Oil Co., originators and licensors of the TCC process, in the design and construction of the prefabricated units. Engineering design of the catalytic cracking section is being handled by Socony, with the balance of the plant (feed preparation, product recovery and stabilization) being engineered and detailed by SWECO, (Southwestern Engineering). All shop fabrication and assembly will be taken care of by SWECO.

Uses Standard Type Derrick

A unique feature of the design is the use of a standard oil field derrick as the main supporting structure for the catalytic hopper, reactor and regenerator, as shown in the above photograph of a scale model of one of the units.

The catalytic section, Socony engineers state, incorporates all the latest developments in the TCC process, including the use of air lift instead of bucket elevators for moving the catalyst through the system.

According to SWECO, the new packaged units are "sized and priced for the independent operators . . . who for so long have been economi-



SWECO HAS PREFABRICATED catalytic cracking units before. This 97½-ft. vessel, a Fluid reactor-regenerator-stripper, was built in their shops last year and shipped to Texas for Panhandle Producing and Refining Co.

cally unable to produce sufficient quality of high octane gasoline from their crude stocks."

The units are available in two sizes, covering a range of throughput varying from 1,000 to 8,000 b/d. The smaller unit has a nominal charge capacity of 3,000 b/d, and the larger of 6,000 b/d.

Costs $100-125 Per Barrel

Arthur V. Danner, manager of Socony's Process Promotion Division, told PETROLEUM PROCESSING that the cost of the packaged unit would be "in line with the per barrel cost of the larger 15,000 b/d TCC units now being installed." He estimated that the TCC catalytic section would cost about $100-125 per barrel, installed and erected, for the 3,000 b/d unit. Including all new feed preparation and recovery facilities, he said, would about double the cost, making the range $200-250 per barrel.

Licensing of the TCC units to operate under Socony-Vacuum patents is being handled by Socony, who guarantees process and yields. Royalty fees are charged in one of two ways—paid up or running. The paid up rate is $50 per daily barrel (annual average) of fresh feed to the TCC reactor. The running rate is 3c per barrel of fresh feed.

Payout in 1-3 Years

It is estimated that the payout period for most installations will vary from one to three years.

In a letter sent to 125 independent refiners last month, Robert P. Miller, president of SWECO, stated that his company was prepared to quote a fixed price for either unit, completely erected and ready for operation. He also explained that:

"The components of both the small and large plants are amply designed to meet the requirements of practically all types of feed stock. Therefore, it is not anticipated that any changes will be made in these plants to fit the individual requirements but rather that net yields will be computed in each case based on the feed stocks to be used. Only by this method—with each plant a standard—can minimum cost be maintained."

The oil field derrick which is used to support the catalytic cracking section is a standard type—nearly 200 ft. high and one of the largest available. It is provided with additional corner bracing, and is designed to withstand a 100 mile per hour gale. A stairway is installed in the derrick to the top of the reactor, and ladders with safety cages are provided from that point to the top.

Also Used for Construction

In addition to serving as the supporting structure, the derrick also serves as a construction rig while the plant is being erected, thus reducing the time and cost of erection. SWECO engineers estimate prefabrication will reduce by nearly half the time required to build a plant, so that one can be installed and in operation within 6 to 8 months after the letting of a contract.

A complete "package" is composed of three units: (1) feed preparation, (2) catalytic section, and (3) stabilization section. The feed preparation section consists of a fired heater, tar separator and synthetic crude tower. The catalytic section is composed of the TCC reactor, regenerating kiln, lift pot, lift pipe, catalyst-air separator, catalyst cooler and catalyst storage. The stabilization section consists of stabilizer, compressor and heat exchangers.

In addition to these three units, the plant includes control house, semigraphic control panel, compressor building and all auxiliaries such as pumps, blowers, heat exchangers, reflux drums, piping, supporting structures, foundation, etc.

Prefabrication of catalytic cracking vessels is not a new venture for Southwestern Engineering. One of their most recent jobs was the shop fabrication of the regenerator, reactor and stripper for the new 1,500 b/d Fluid unit of Panhandle Producing and Refining Co. at Wichita Falls, Texas. The unit, 97½ ft. in over-all length, was shipped intact from SWECO shops in California to the Texas plant site.

For the TCC units, SWECO plans not only to fabricate the vessels in the shop as completely as possible, but also to install kiln lining, trays, and other internals wherever practical. For the most part, the reactor, kiln, fractionator, furnace and the like will need only to be set on foundations and connected.

Uses Air to Lift Catalyst

Catalyst flow through the catalytic cracking section is similar to that through the larger modified TCC type unit. Catalyst flows from the separator at the top of the derrick, through a standpipe and into the reactor, out of the reactor and into the regenerator kiln, out of the kiln and into the lift pot at ground level. All of this flow is by means of gravity. From the lift pot the catalyst is raised with compressed air through a 15-in. lift line (running vertically through the center of the derrick) to the catalyst-air separator at the top.

Only a very low air pressure is required to raise the catalyst—about 3 psi.—and the same single stage centrifugal blower which provides air for the lift line also provides regeneration air for the kiln.

Catalyst used is the same type as employed in previous TCC units—either bead or pellet form. The 3,000 b/d unit, according to Socony's engineers, will circulate about 90 tons of catalyst per hour, at a catalyst to oil ratio ranging from 3:1 to 5:1. Catalyst makeup, they say, will be less than 0.4 ton per day—with less than half of that due to attrition.

Considerable importance has been paid by SWECO to corrosion protection—and all units are designed to operate on sour crude. The fractionator up to and including the No. 2 fuel oil drawoff tray and the entire flasher are clad with 12% chrome. The reactor shell is clad throughout the hydrocarbon space with 12% chrome, and an alloy liner is installed inside of the insulation in the kiln. Most of the internals in both the reactor and kiln are alloy.

The derrick is fire proofed approximately 20 ft above grade, and is galvanized to resist atmospheric corrosion above that point.

FURNACE FALLACIES . . .

• Yellow Flames Indicate Poor Combustion—FALSE
• Furnace Gas Flow Is Gentle and Slow—FALSE

Case Histories Show That When These Accepted "Facts" Are Discarded, Capacities Can Be Raised 20% or More

SEVERAL commonly-accepted theories concerning the design of process heaters were demonstrated to be fallacious and causes of lost processing capacity when some 200 refinery technical personnel gathered in Tulsa June 10 for the first Process Heat Seminar sponsored by the John Zink Burner Co.

The complete program covered a variety of subjects, including metallurgy and casting design, waste heat recovery economics, and design for radiant heat transfer.

A number of new factors which apparently have escaped recognition by heater designers were brought out in the paper "A New Approach to Design for Radiant Heat Transfer in Process Work," by R. D. Reed, chief engineer, John Zink Burner Co.

Pointing out that in establishing the radiant characteristics of a furnace three important factors are considered; (1) radiation from the flame bursts, (2) radiation from hot refractory planes, and (3) radiation from the carbon dioxide and water content of the flue gases. Mr. Reed said he had found there was a very definite relationship between the hydrogen-to-carbon ratios of the gases and the relative radiation ability of their flames. This may explain why operators show a preference for heavy refinery gases over methane. Further, the almost universally held opinion that yellow in a flame is an indication of inefficient combustion is fallacious. Radiation from yellow or luminous flames may be from 19 to 225% greater than from a clear blue flame. That explains why the radiant factor from an oil flame is much greater than from gas, although the hydrogen-to-carbon ratio further increases the radiation effect.

One of the most important factors often overlooked, according to this authority, however, is the manner in which furnace gases circulate in the heater and the influence of furnace design on this circulation. Common understanding has it that these gases flow more or less gently toward the exit, and apparently there is a progressive loss of heat from burner to bridge-wall. Actually, the flow is anything but direct and experimentation has verified the existence of a thermo-siphon effect set up by the tubes themselves, in addition to the turbulence caused by the discharge of gases away from the burners.

This little known siphon effect results from cooling the gases by contact with the tubes, whence the gases become denser and descend between the tubes and furnace wall with observed velocities up to 300 to 500 ft./min. This is equivalent in quantity of gas involved in a wall-tube furnace to 25 times the entire furnace volume in one hour.

This phenomenon has considerable effect on the ability of the furnace to handle its rated load; two actual case histories were cited as examples. In the first, a failing furnace wall was rebuilt in such a manner that the wall almost touched the tubes. Before the rebuilding, the furnace had handled with ease much more than its designed load; afterwards its capacity proved to be only 60% of its former duty. The reduction is considered largely due to lack of opportunity for the thermo-siphon effect to occur, since the reduction in re-radiated heat from the rebuilt wall, because it now is shaded by the tubes, is believed insufficient to explain the observed loss of capacity.

Second Example

The second example resulted from the deliberate rebuilding of a furnace wall so the observed descent of the column of flue gas behind the tubes would not blow burner flames toward the center of the furnace. Bricks were laid parallel to the tubes and almost touching them, but there was no interference with the delivery of radiant heat to the wall or re-radiation to the tubes. When it went back on-stream its capacity had fallen 20%, although the flames no longer were blown toward the center of the furnace.

A second rebuilding, designed to restore the gas circulation behind the tubes but to keep it from interfering with burner action (a wall 12½ in. high, almost tangent with burner openings and running the length of the furnace), not only restored the lost duty capacity but permitted the heater to handle 20% more oil than it ever had handled in the past.

Mr. Reed recommended providing adequate clearance for circulation between tubes and heater wall, using a minimum of a half tube-diameter between tube and wall with additional clearance indicated if economics of construction will permit, particularly tube hanger cost.

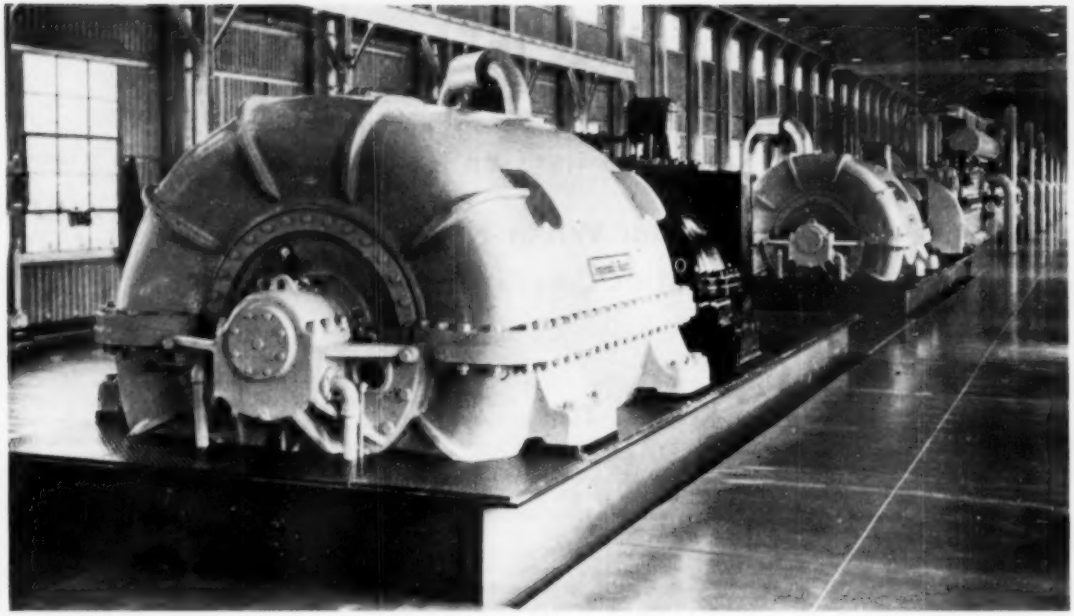
Saving Waste Heat

The savings possible by the use of heat in refineries which otherwise would be wasted, developed by careful survey and continued supervision, can amount to 10% of an annual million dollar fuel bill, L. D. Stewart, Mid - Continent Petroleum Corp., stated in his paper, "Economics of Waste Heat Recovery."

Great savings can be achieved by the proper utilization of heat otherwise wasted, and in general heat is more valuable than the exchange surface required to utilize it, but if not watched carefully the cost of exchanger surface can quickly get out of bounds, Mr. Stewart stated.

As an example of the profit attainable from heat exchange the preheating of oil entering a pipestill was cited, wherein the exchanger duty was set at 6400 MBtu./hr., requiring a surface of 1990 sq. ft. at an installed cost of $5500. To cool the products with water and to have heated the oil in the furnace to the extent provided by the exchange surface would have cost $22.90/day. Thus the exchanger installation paid out in 240 days.

The essence of savings accruing from the use of waste heat boilers generally is not in the saving resulting from not using cooling water, since the expense of removing heat from the process streams either by cooling with water or in generating with steam is practically the same. Examples cited clearly showed this for a typical 15,000 b/d fluid catalytic cracking unit, where cost of cooling with water was $61.34/day and that for generating steam, $59.35. The saving lies in what it would cost to produce the steam required by the unit (or elsewhere in the plant) in the power plant, where the heat is not "free" but would have cost $355.20/day for an equivalent amount of steam.



CENTRIFUGAL COMPRESSORS are used for the first time to handle incoming casinghead gas in the new Seeligson combination cycling and natural gasoline plant. Two 6-stage compressors are installed, each designed to compress 35,000 Mcfd from 10 in. Hg vacuum to 36.6 psig. Both units are driven by . . .

New Seeligson Plant Makes First Use Of Centrifugals to Compress Raw Gas

Saving of $30 to $35 per Horsepower in Investment Cost Estimated with this Type of Equipment in First Stage Compression. Expect Operating and Maintenance Costs To Be $5 to $7 Less per Horsepower Year

By D. P. Thornton, Jr.
Southwestern Editor

THE first gas processing plant to use centrifugal compressors to compress a part of its raw gas is now in operation near Fremont, Texas. It is known as the Seeligson Field plant and is operated under unitization by Magnolia Petroleum Co.

The Seeligson plant is one of the largest combination cycling and natural gasoline plants to be placed on stream in 1950. It is designed to produce a variety of pure products from ethane through LP-gas, motor fuel and light gas oil at the design rate of nearly 500,000 gal. per stream day. Total gas throughput is 220,000 Mcfd.

Aside from the use of centrifugal compressors, there are a number of unique features about this plant. Among them are:

1. Provision for production of 95% pure ethane and future production of specialty gasoline fractions.

2. Refrigeration of casinghead gas, much of the lean oil and de-ethanizer reflux.

3. A Dowtherm vapor heating system for heavy products fractionators.

4. Compressor station with full basement containing auxiliaries.

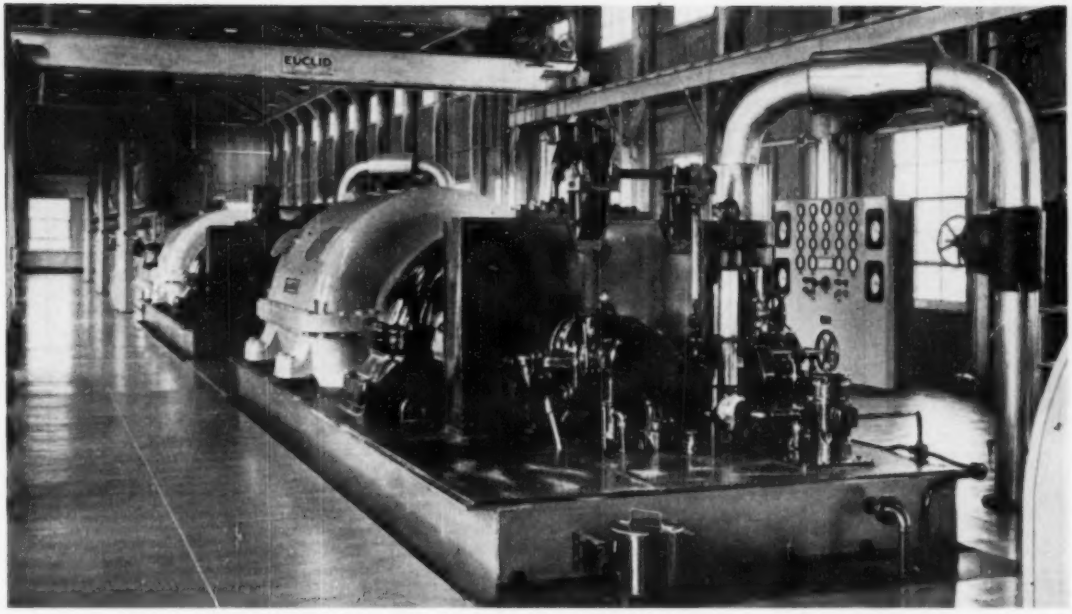
5. Unusual waste water disposal system.

6. A high-pressure steam plant operating total-condensing and supplying most of the process heat and power needs at three pressure levels.

The plant was designed and built by Hudson Engineering Co., in cooperation with a committee of engineers representing the various operators. Magnolia Petroleum Co. operates the plant and also the cycle portion of the field. Black oil is not unitized and is operated by individual owners.

Why Centrifugal Compressors?

Extensive study of reciprocating vs. centrifugal compressors was made before selecting centrifugals for the first compression stage at Seeligson. While referring the interested reader to the literature for a discussion of the two types, suffice it here to say that the particular value of these units in the Seeligson application lies in their ability to operate economically from 50 to 120% of design rating, low maintenance costs and inherent flexibility in view of the large volume of gas to be handled at low pressure. It is believed installation of these



. . . STEAM TURBINES, operating total-condensing with 600 psig., 825° F. primary steam, and consuming 50,000 lbs. per hour at design load. Centrifugals were chosen for the first compression stage because of their efficiency and flexibility over a wide range (50 to 120% of design rating) and low maintenance costs

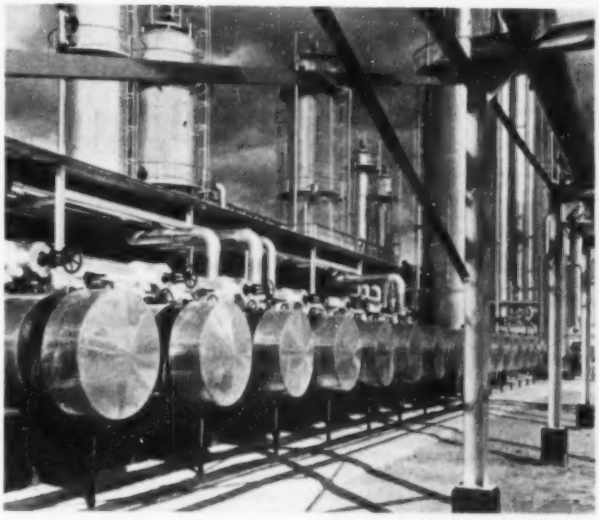
units could have been justified in handling as little as 15,000 Mcfd. of gas at this low pressure.

These units now are operated to supply gas at constant pressure to the suction of the reciprocating engines, regardless of variations in field gas pressure or volume. Since present casinghead gas supply to the plant because of oil proration now amounts to approximately 30,000 Mcfd., speed of the units is merely reduced correspondingly below the design value of 3870 rpm and only one unit normally is in service. As more gas becomes available, up to the ability of the present reciprocating compressor to handle it, the speed will be increased and the other unit put on the line when needed. By keeping reciprocating compressor suction pressure constant, individual reciprocating compressors can be added to or taken off the line as the casinghead gas supply volume fluctuates.

Magnolia engineers estimate an investment saving between $30 and $35 per horsepower by putting centrifugals on the first compression stage job. Operating and maintenance costs are expected to be $5 to $7 less per horsepower-year but no actual data are available.

Economics are against using centrifugals for all compression requirements because gas volumes are reduced at the higher pressure, thereby calling for smaller machines; in

THIS MONTH'S COVER PICTURE



"SLIP COVERS" PROTECT INSULATION on heat exchanger heads in the Seeligson plant. The covers are shop fabricated of .024 flat aluminum and are easily removable. Insulation on the head is so shaped that each bolt can be removed without damaging the insulation. Exchanger shells also are covered with .024 sheet aluminum, and principal vessels with corrugated aluminum.

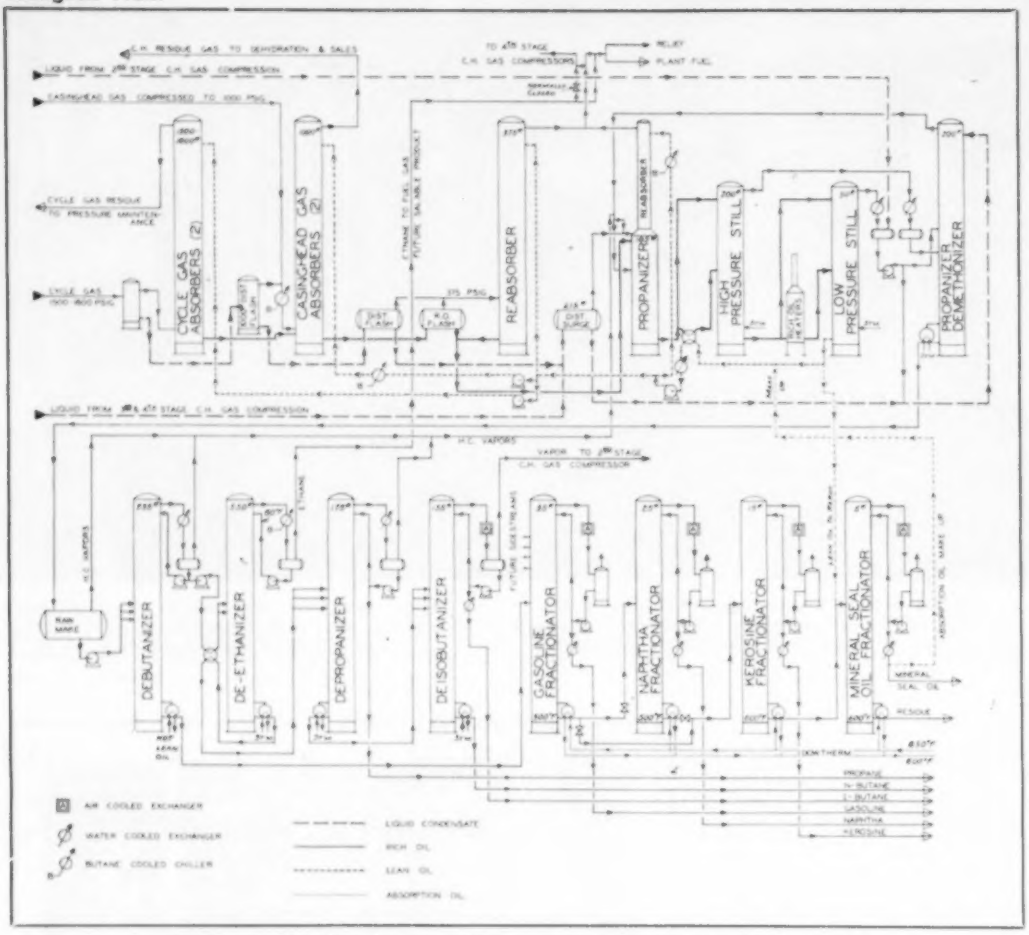


FIG. 1—Simplified flow diagram of the processing arrangement at Seeligson plant

turn sealing problems and investment in standby units go up with the smaller, higher-stage units. Consequently the only other place centrifugal compressors are used at Seeligson is for refrigeration duty. There again volumes are large, compression ratios are not great and operating flexibility desirable.

Designed for 220,000 Mfcd.

Seeligson is rated to handle 150,000 Mcfd. of distillate well gas and 70,000 Mcfd. of oil well gas at an overall efficiency of 75% propane extraction. Oil well gas is gathered at substantially atmospheric pressure, the residue being supplied to a gas transmission line at 1000 psig. and to leases for gas lift and fuel use. The dry cycle gas is returned to the reservoirs for pressure maintenance. At the present time the compressor station lacks two compressors, which would enable it to handle the entire 70,000 Mcfd. rated casinghead gas load for which the plant itself is designed; these will be added when field production warrants. The plant site occupies 65 acres.

To give an idea of the size of the plant and its production, Table 1 has been prepared to give the design volume of products and the storage capacity. In general a minimum of five days tankage has been built for every product which the plant is capable of making. Floating roof gasoline tanks each have two "Lightning" in-tank mixers for blending.

Gas Processing Section

Cycle gas, of the design composition indicated in Table 2, is brought into the plant at 1800 psig., cooled, scrubbed, and split between two cycle gas absorbers operating at from 1500 to 1800 psig. Following absorption cycle gas is boosted to reinjection pressure of 2700 to 3500 psig. by one compression stage using four 1600 Hp. reciprocating compressors. Some casinghead residue gas also may be diverted to pressure maintenance via a reciprocating compressor discharging at cycle gas suction pressure.

Casinghead gas, the design composition of which is shown in Table 2, enters the plant from lease separators through four 24-in. and one 20-in. lines to an inlet scrubber from which two parallel 6-stage steam-driven Ingersoll-Rand centrifugal compressors take suction at pressures ranging from atmospheric to 10 in. Hg vacuum, boosting the gas to 36.6 psig. A battery of eight Clark reciprocating compressors of 1600 Hp. each raise the gas to 1000 psig. through three more stages. This gas is chilled with butane to 70° F. before splitting to the two casinghead

gas absorbers. Dry gas is dehydrated in three paralleled dehydrators (two on-stream, one regenerating), one tower of which is filled with S.V Sovabeads and the other two with activated alumina.

Lean oil amounting to 600 gpm. is supplied to each of the cycle gas absorbers, the rich oil being flashed into the base of the casinghead gas absorbers. The lean oil supply to the casinghead gas absorbers is 410 gpm., chilled with butane to 70° F.

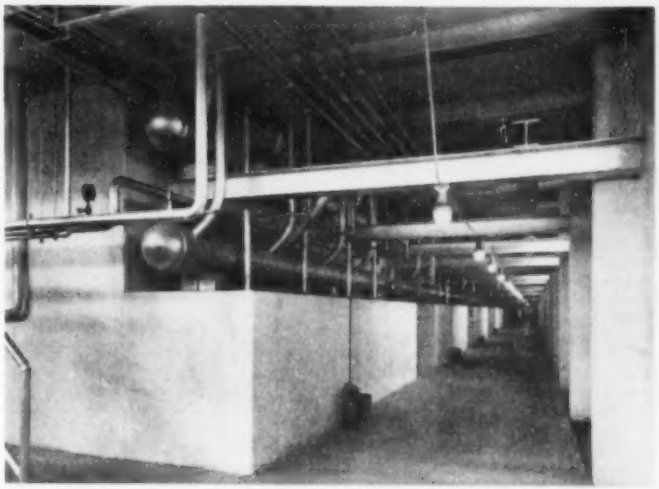
The chilling of lean oil and casinghead gas grew from the economic advantage of expanding the refrigeration system after it was decided to refrigerate the de-ethanizer reflux. Plants usually are designed without chilling lean oil and wet gas, this feature being incorporated later if desirable to increase recovery of propane. Reabsorber lean oil likewise is chilled. The refrigeration system consists of two 600 Hp. steam-driven Carrier centrifugal compressors and is otherwise conventional; design flow of butane to chiller coils is 326 gpm. at 15 psi. and 67° F.

Rich Oil and Condensate Processing

Processing from this point on becomes complicated by reason of the many recycle streams which give the plant its flexibility. As an aid to the reader a simplified flowsheet is provided, Fig. 1.

Rich oil from the cycle absorbers is commingled with that from the casinghead absorbers in the base of the latter. Condensate from the cycle gas inlet scrubbers also is flashed down to 1000 psi., the vapors entering the casinghead absorber slightly above the casinghead gas inlet. The commingled rich oil is flashed to 375 psi. and condensate from the previous 1000 psi. flash is again flashed, the mixed vapors entering a reabsorber supplied with lean oil. Originally this vessel was intended to produce lean vapors from these two flashes for lease fuel use, but assumed present status when it was decided to supply gas lift and lease fuel gas at 1000 psi.

A "propanizer reabsorber" is used to selectively stabilize the rich oil and distillate vapors. This unit is in effect two towers, the top section being a reabsorber, and supplied with lean oil. Vapors from the distillate surge tank, rich oil flash and ascending vapors from the propanizer section are reabsorbed here. The rich oil is flashed in the top of the propanizer (bottom section). In the propanizer section uncondensed still vapors from raw product recovery act as a stripping medium in a "cold fractionation," thereby relieving the rich oil of much of its methane and ethane content. This overhead stream is used as plant fuel gas. An interesting point here also is that lean oil fed to the absorber section is refrigerated.



BASEMENTS ARE UNUSUAL in petroleum processing plants, but Seeligson has one under its compressor station, housing volume bottles, oil coolers, fuel controls and other engine auxiliaries. The basement provides ample working space to get at this equipment for servicing and eliminate unsightly floor gratings in the compressor room

TABLE 1—Design Products Capacity and Storage Facilities

Product	Production, Gal. Day	Storage Tanks	Capacity, Bbls.
Ethane	2,861*		
Propane	110,000	11	15,250
n-Butane	72,000	9	13,500
i-Butane	52,000	6	9,000
Gasoline	230,000	6	60,000
Naphtha	16,000	2	5,000
Kerosine	21,000	2	5,000
Mineral Seal Oil	6,000	2	2,000
Residuum	4,000	2	2,000
Total	511,000	42**	112,750**

* Mcf/day, 95% pure.
** Including crude oil storage, two 500-bbl. tanks.

TABLE 2—Design Composition, Cycle and Casinghead Gas Inlet Streams

Component	Cycle Gas, Mols/Day	Casinghead Gas, Mols/Day
Methane	358,421	149,118
Ethane	16,224	14,497
Propane	6,789	8,880
i-Butane	1,618	2,542
n-Butane	2,132	4,182
i-Pentane	908	1,639
n-Pentane	750	1,142
Hexane	587	2,229
Heptane +	6,908	
TOTAL	394,737	184,209

Fractionation Section

Two stills have been used to reduce overall process heat requirements and stripping steam volume. Both are unusual in that neither are refluxed with their overhead product. The high-pressure still is refluxed with rich oil from the propanizer reabsorber and the low-pressure still with a drag stream of partially-stripped and cooled bottoms from the high-pressure still. There are two principal advantages to this arrangement; the saving of one reflux pump per still and simplicity of operation. The end point of gasoline is not a problem here since end point is set in the gasoline fractionator later in the process.

Overhead product from the high pressure still, which operates at 200 psig., is only partially condensed, since it consists mainly of propane and lighter hydrocarbons. It is part of the feed to the propanizer demethanizer. Steam requirement at design conditions is 5160 lbs. per hour of 250 psi. steam. It will be noted no process heat other than that acquired by cooling lean oil from the low pressure still is supplied to this column, except from the stripping steam.

The low-pressure still operates total condensing at 50 psig. The feed is heated to 525° F. in paralleled Petro-Chem heaters. Stripping steam amounts to 8355 lbs. an hour of 50 psi. steam. Although separate accumulators are used, product from the two stills feeds the propanizer-demethanizer, where all the remaining methane and some of the ethane and heavier components are taken overhead and returned to the propanizer-reabsorber.

A unique feature of the stills and the propanizer-reabsorber is that the stripping trays, below the feed tray,

are not the conventional bubble-cap arrangement. These trays consist of a layer of Raschig rings so arranged that a positive liquid level always is maintained on the tray. Instead of the usual vertical flow of vapor from tray to tray, liquid flow is vertical and a cross-flow of vapor is achieved. This gives the tower a very large liquid capacity without the necessity of sizing diameter for more than the anticipated vapor load. Patents have been applied for on the arrangement.

The propanizer-demethanizer concentrates all the raw product make. All the stage flashed distillate comes over the tower as reflux while a steam-heated reboiler supplies the necessary heat. The bottom product goes to the feed tank, vapors from which (normally none) return to the propanizer-reabsorber.

A split is made at the C_4 level in the raw make by the debutanizer. This conventional column is operated to provide the desired vapor pressure on the finished gasoline which, along with other heavier materials, is produced as a bottom product. The overhead, butane and lighter, is successively de-ethanized and depropanized, and the remaining butane charged through a deisobutanizer.

The de-ethanizer, which operates at 550 psi. as against the debutanizer at 235 psig. from which it draws its feed, is capable of delivering nearly 3000 Mcfd. of 95% pure ethane overhead product. The reflux is chilled with butane, as mentioned earlier.

Gasoline—either natural or clear motor fuel—is the first product split from the heavy fraction. Since the vapor pressure has been fixed by debutanizing, this column is controlled for product endpoint. Connections also have been provided for future production of several specialty gasoline side cuts, which may include the pentanes, hexanes and any cyclic hydrocarbons in this boiling range. The motor fuel base stock now produced will meet present "regular" and "premium" octane requirements with the addition of tetraethyl lead.

The next product to be split from the heavy fraction is naphtha, followed by kerosine and mineral seal (absorption) oil. The small amount of residuum remaining as bottoms from this last column is sold as crude oil. The column also functions as an absorption oil reconditioner.

Construction Features

A unique feature common to all the heavy products fractionators is the use of Dowtherm vapor for process heat. Two Dowtherm vaporizers, operating at 65 psig. and 650° F., supply vapor to reboilers associated with each column. Although relatively new to the natural gasoline industry, Dowtherm is not new to industry in general. Here it is used to permit very close and flexible heat control at temperatures higher than normally achieved with steam. The vaporizers are gas-fired, Union Iron Works 2-drum boilers.

Extensive use of aluminum sheathing has been made to protect insulation and minimize painting. Corrugated sheathing has been used on principal vessels, while smooth sheet protects lines. The process columns are placed in a double row, forming what might be termed "Hydrocarbon Avenue." Between the two rows of columns control panels are located; there is no central control room. In the center area are the associated process pumps and overhead the pipe racks, which also support a transite shed roof. Accumulators and condensers are located to the "outside" of the columns, sufficiently high to provide gravity flow to pump suctions.

The covered walkway extends to the boiler house, outside which all heaters are located, and to the nearby generator room. On one side of the process area is the 572-ft. long compressor station, which has a full basement. The building has three sets of full-span traveling cranes, two serving the reciprocating compressors, and the third the centrifugal compressors.

All the piping generally associated with compressors, volume bottles and the like, is in the basement. Here also are the lubricating oil coolers, gas regulators and other auxiliary equipment. Principal reason was to provide ample workroom for this equipment and to eliminate unsightly floor gratings.

Plant Auxiliaries

One of the interesting facilities of this plant is the arrangements which have been considered necessary to avoid stream pollution. Since the area is flat and predominantly ranch land and the waste water volume, mostly cooling water system blowdown, rather high in mineral content, unusual measures have been taken to avoid any possibility of surface water contamination. Ponds are not feasible because of size and likelihood of overflow from surface drainage.

The system installed can treat up to 5000 bbl. of plant waste water daily. Water entering the disposal system goes through settlers where solids drop out and any oily material is skimmed off. Coagulation of suspended matter is achieved with ferrous sulfate and activated silica and subsequent filtration. Ordinarily, this treatment would be sufficient, but the water is to be injected into two salt water wells at the 3000-3300 ft. level. Consequently it is chlorinated for sterilization, which prevents growth of sulfate-splitting bacteria and the formation of gelatinous substances on the sand face of the injection formation. Control of pH with carbon dioxide to prevent sand plugging also is necessary.

The steam system is unusual for a cycling plant. Three Babcock & Wilcox boilers, rated at 75,000 lbs. per hour each, furnish steam at 600 psig. and 825° F. (about 340° of superheat). Any two of these will supply plant needs, which are calculated at 135,000 lbs. per hour. The Ingersoll Rand turbines driving the centrifugal casinghead gas compressors consume 50,000 lbs. an hour of this, and the balance is utilized to drive the turbines on the centrifugal refrigeration compressors and the turbines driving the lean oil pumps serving the cycle gas absorbers. Turbines on the centrifugal compressors operate total condensing; the others exhaust at 250 psig.

The 250 psig. secondary steam system furnishes power to all turbines driving boiler auxiliaries and all other process pumps, and supplies stripping steam for the high pressure still. These turbines exhaust at 50 psig., which tertiary system supplies all reboilers, heats evaporators for boiler feedwater makeup and supplies low pressure still stripping steam.

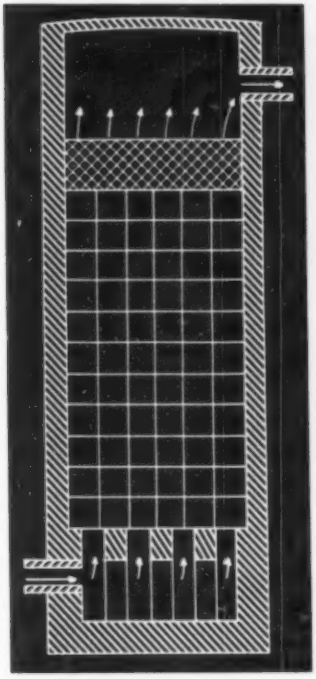
All plant condensate is returned to the boilers. "Clean" condensate is utilized without treating, while oily condensate is skimmed, then cleaned of suspended matter by coagulating with alum.

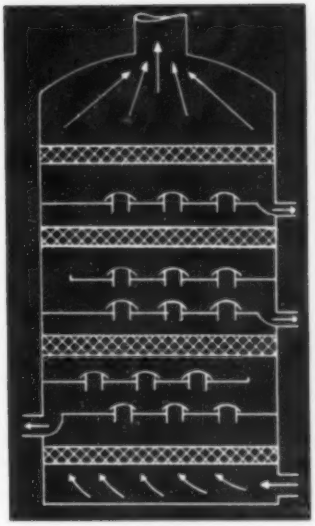
Electric power is generated with five 675-Hp. gas engines. The principal consumer is the Hudson cooling tower, which has 28 cells and circulates from 28 to 30,000 gpm. Induced draft fans are 25 Hp. each. Water makeup for the plant comes from wells on the plant site, drilled to 2400-2500 ft. It is unusually soft but is high in carbonates, sulfates and chlorides. Engine jacket water is in a closed system, and is cooled by exchange with cooling tower water.

Both water and air cooling is used in the plant. In general, Hudson air coolers are used to cool the overhead products from the butane splitter, gasoline, naphtha, kerosine and mineral seal oil fractionators.

Products may be shipped by rail, tank truck or pipe line. The tank car loading rack will handle 24 cars at once, with storage space for 24 more cars. A special feature of this installation is that any product may be loaded at any spot. The pipe line moves products into the Corpus Christi area. The T.&N.O. railroad passes by the plant and is paralleled by U. S. Highway 281.

Adjoining the plant is a complete gas district office, warehouse and a small machine shop. A 40-acre camp site containing a recreation center and 20 houses is located at the nearby city of Premont.





TYPICAL INSTALLATIONS in refinery equipment for knitted wire mesh entrainment separators. FIG. 1—Left: in a packed tower just below the vapor outlet. FIG. 2—Above: as a series of grids across a fractionating tower

Entrainment Separation By Use of Wire Mesh

KNITTED wire mesh, in common use in the dishwashing trade as an aid in scouring pots and pans, now is finding application in petroleum processing equipment as an entrainment separator. It removes liquids entrained in the vapors in such units as fractionating columns, vacuum pipe stills, scrubbing towers, knockout drums, evaporators, and the like.

The physical make-up of the material provides a large surface area along with a high free volume. It therefore presents a low pressure drop to vapors passing through it, yet is an efficient means for catching entrained liquid particles. It also occupies considerably less space than conventional baffles and similar arrangements which are occasionally used for the purpose.

In the form of a tailor-made unit for installation in refining equipment, one commercial wire mesh entrainment separator has been in use in several eastern and Gulf coast refineries and also in going into new units in a number of other plants, according to the manufacturer. As described in data furnished PETROLEUM PROCESSING* the product is made of corrosion-resistant wire which first is knitted into a mesh and then assembled into three-dimensional sections—or pads—to fit the shape and dimensions of the tower, drum, or vessel in which it is to be used.

Pad sections are built up to the desired thickness from multiple layers of the mesh. Each layer is crimped diagonally and laid with crimps at right angles in successive layers to control the percentage of free volume in the pad. This construction makes it impossible for gas or vapor to go straight through, yet there is little flow resistance because of the large free space. Liquid droplets caught by the wire surface accumulate to sufficient size to drop off against the flow of the air, gas, or vapor.

An entrainment separator for a tower or column is then made up by assembling pad sections of the proper shape and dimensions to form a horizontal layer across the inside of the vessel at the desired level. The sections are very easily passed in through a manhole. The layer can be made any thickness. To date it has usually been suppiled in thicknesses of 2½, 4, and 6 in. For small diameter vessels, the manufacturer recommends a single round unit, knitted of one continuous piece of wire.

When used in refinery fractionators, the separator can be placed above the feed inlet, or at any point of product removal where entrainment is critical for product quality control. Fig. 1 illustrates a suggested installation of a series of layers of the mesh in a fractionating column.

For vacuum pipe stills, several separators are suggested. The most important position is immediately above the feed inlet. In addition to entrainment separation, it helps equalize transverse velocities throughout the tower. In stills operating at high vapor velocities, installation above the feed inlet eliminates or markedly reduces the entrainment of high boiling fractions above the feed plate. This allows the unit to operate at full capacity.

Installations are sometimes made under draw-off plates, where velocities are high enough to carry entrained liquids through the vapor phase. Placing a separator above the top plate reduces the loss of low boiling fractions to the barometric condenser. In any tower, a unit at this point will reduce liquid loss with 98 to 100% effectiveness, it is stated.

Used in a Packed Tower

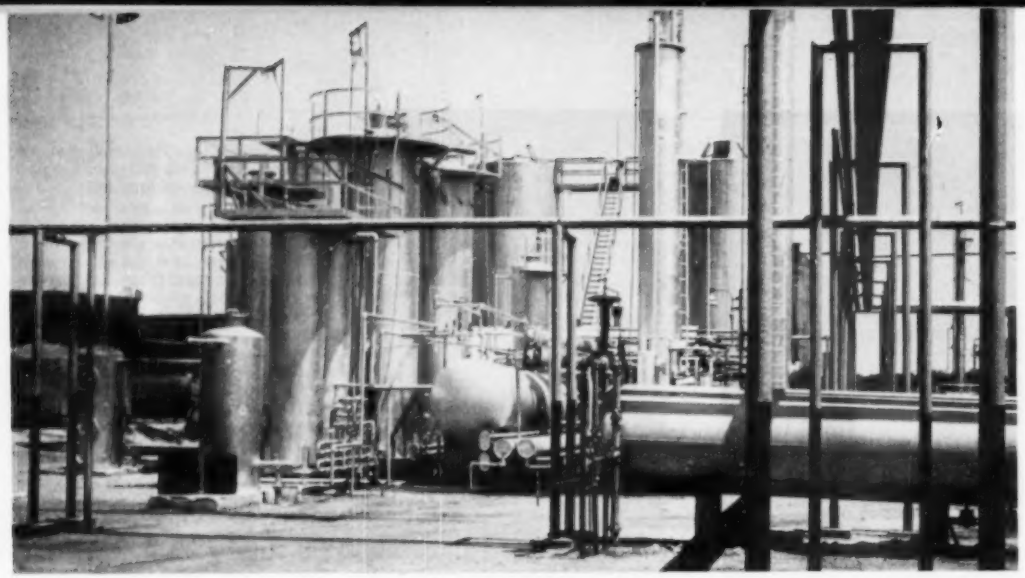
Another typical application is shown in the simplified sketch in Fig. 2. A separator has been placed at the top of a packed tower to remove mist and small particles of liquid that have risen through the packing. Any overhead liquid distribution should be under the separator.

In the distillation of crude oil, a separation efficiency of 98% has been obtained in the range of 2-4 ft./sec. vapor velocity. The range of particle sizes which can be handled effectively depends on the nature of the liquid, its surface tension, and its vicosity. In most cases, this range should be 5-20 microns or larger.

At normal velocities, pressure drop through a 6-in. thick layer is usually less than 0.5 in. of water. In cases where the entrained liquid deposits salts on the mesh, the pressure drop increases and a solvent must be used to wash away the deposits. This can be done by installing a spray head directly above the separator.

Plant installations and laboratory studies have shown that the critical velocity is in the range of 10-11 ft./sec. for air carrying entrained water, and in the range of 6-7 ft./sec. for oil vapors. Viscosity does not have as much effect on the efficiency as wettability by the liquid, of the metal wire used, it is believed.

* Illustrations and information on which this article is based were furnished by Metal Textile Corp., Roselle, N. J.



SAFETY IS PROMOTED by good housekeeping. You can't keep your unit neat with faulty equipment and makeshift repairs

3 Reasons Why Good Housekeeping Gets Top Rating in Maintenance

1–Promotes Healthier Safety Practices

2–Improves Operating Conditions, Yields

3–Impresses Customers and Prospects

GOOD housekeeping gets top billing in the plant maintenance program at the 8,500 b/d plant of Leonard Refineries, at Alma, Mich. In a paper presented at a recent API Refining Division meeting,* Leonard engineers described three main phases of their program—general maintenance, inspection and cleanout, and housekeeping. Of the three, the last was rated first in importance.

Three reasons were given as justifying good housekeeping costs. First, it ties in closely with safety. Rigid controls on housekeeping cannot be maintained along with faulty equipment and makeshift repairs. Policing the unit frequently from the standpoint of cleanliness calls attention to items which would become hazards if neglected.

Second, good housekeeping improves operating conditions and therefore improves yields. Pride in the appearance of their equipment makes the operators more aware of product quality. The man who is conscious of the appearance of his unit is less likely to tolerate sloppy temperature control, steam, water or oil leaks, nor to permit smoking furnace stacks or product streams continuing to run off specifications.

Third, the company's sales department and distributors are encouraged to bring in prospects and customers to inspect the refinery, as it has been found the customer who is impressed by its appearance is easier to sell on product quality.

Regarding the high importance given the housekeeping division of the maintenance program at the Alma refinery, the paper stated:

"We have been accused of bordering on the fanatical in the manner in which we stress this subject. We are firmly convinced, however, that the money spent in good housekeeping pays large dividends. Our control rooms are not tile and marble, and we have no gold plate in the refinery; but we believe we have one of the cleanest refineries in the country.

"A large number of visitors go through the plant and a large percentage of these write us complimentary letters concerning its appearance. These letters immediately become part of our maintenance program; i.e., copies are posted on the bulletin boards of each unit and the locker room. This, we believe helps to uphold the pride of each employe in this phase of his job.

The details of the housekeeping program were described as follows in the paper. Operators of each unit are responsible for the appearance of their unit and do the following work themselves:

1.—Wash, with hose and hot water, all floors of the unit, each shift. If the floor is dirty from an oil spill, a

*"Maintenance Practices in a Small Refinery", by John S. Pfarr, Robert W. Pollard, Leon T. Harris, and William F. Dougherty, presented before the Session on Refinery Maintenance, 15th Mid-Year Meeting API Division of Refining, Cleveland, May 3.

John S. Pfarr is vice president in charge of manufacture, Leonard Refineries, Inc., Alma, Mich.; Robert W. Pollard is general superintendent of the Alma refinery; Leon T. Harris is maintenance superintendent; William F. Dougherty is refinery engineer.

hot solution of Oakite Penetrant and kerosine is used in those spots.

2—Keep all packing glands on valves and pumps adjusted so that there are no leaks. In an emergency, they are to add necessary rings of packing. In the case of pumps on which leakage cannot be avoided, and when it is not practical to pipe this leakage to a drain, they maintain pans underneath the gland.

3—Clean up any spills as soon as possible. Major spills, of course, are handled by the maintenance department.

4—Pick up all trash, rags, etc., around the unit and put them into closed receptacles for that purpose. During spring, summer, and fall, each morning before the shift change, the limestone-chip-covered area around the unit is raked.

5—Inspect a job before the maintenance department is released from its responsibility for proper performance of the job, and before the operators again assume responsibility for the appearance of that particular part of the unit.

6—Request assistance, through the assistant superintendent, from the maintenance department when operators are temporarily unable to keep their unit in shape. This is usually due to some operating difficulty.

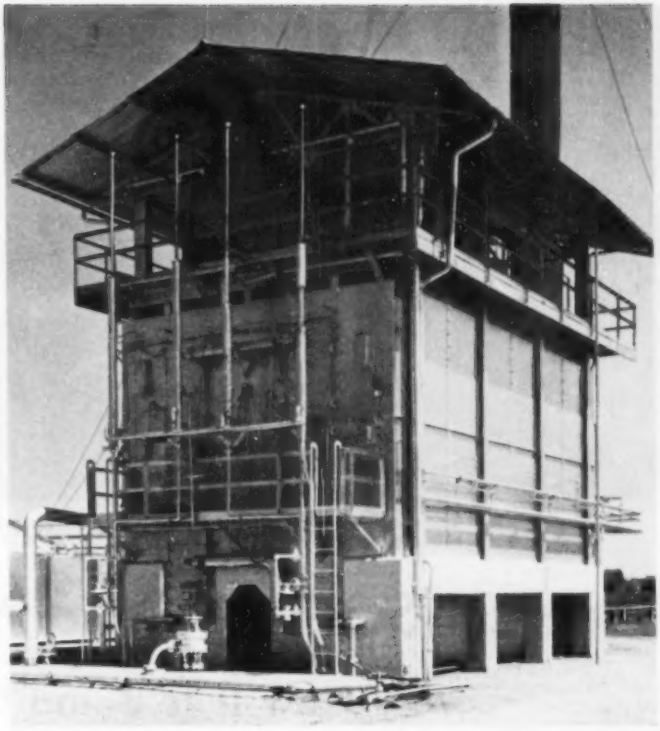
Duties of Maintenance Staff

The maintenance department is responsible for the following duties in the housekeeping phase of maintenance, without special requests from either the general or assistant superintendent:

1—Maintain clean and sanitary conditions in the following: a. Locker room, b. Plant offices. Work in locations (a) and (b) requires the services of one man full-time. c—Water pump house, d—Truck-loading pump house, e—Fire house, f—Washes all windows in plant except locker room, plant office, laboratories, and boiler house. (Laboratory and boiler-house personnel wash their own windows). The work from (c) through (f) requires the services of one man full-time.

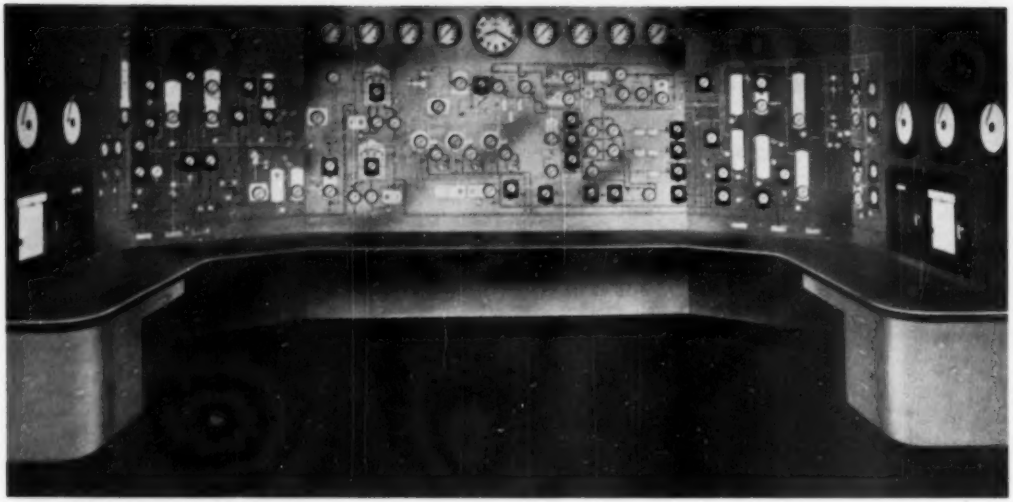
2—Two men and a pickup truck are scheduled one-half day each day for general plant cleanup. These men empty all trash and rubbish barrels, deliver all used valves and fittings to the salvage department, and assist the units when so ordered.

3—On Saturday morning the personnel of the entire maintenance department, except those on emergency jobs, take over the general plant cleanup. From 8:00 am until 12 noon they work in cleaning and putting in order all shops, trucks, and equipment. The maintenance department does not work on Saturday afternoon or Sunday.



PRODUCTS ARE IMPROVED. Operators who are conscious of the appearance of their equipment are less likely to tolerate sloppy operations—with the result that product quality is kept at a higher level

CUSTOMERS, PROSPECTS ARE IMPRESSED by the appearance when they visit Leonard's plant—making it easier to sell them product quality



THE NEW—Sohio's graphic console panel designed for the lube plant at Lima

The CONSOLE Graphic Panel

How It Is Being Used for Control Of a Lube Oil Processing Plant

By **WALTER S. BOWERS** *Instrument Engineer*
Standard Oil Co. (Ohio), Cleveland

Modern petroleum refineries are being developed for higher throughputs with a minimum of storage space between processing stages. Better process control is achieved by making efficient use of an operator's intelligence through the employment of graphic console instrumentation. A careful analysis of this modern instrumentation is made by a refinery user of the equipment.

Standard Oil Co. (Ohio) has been one of the pioneers in this development and evolved a satisfactory design for use in a new solvent refining and dewaxing lube oil plant. The author describes the console panel recently installed at Sohio's Lima refinery, discussing advantages and disadvantages, and presents some cost comparisons with conventionally designed instrument panels. It is interesting to note that the development work and planning preceded the first public announcements of graphic panel design at the Instrument Society of America's annual conference last fall in St. Louis. The present article, now brought up to date, was originally prepared in early 1949. It was first delivered as a paper at Sohio's Mfg. Dept. Engrg. Conference, French Lick, Ind., in October, 1949, and subsequently given at a meeting of the Cleveland section of the Instrument Society of America in November. It has now been made available to the readers of PETROLEUM PROCESSING through the cooperation of Sohio.

ONE picture is worth a thousand words! This theme, used so successfully by the advertising profession for many years, is the control engineer's basic approach to this thing called graphic instrumentation. The console type of pictorial, or "graphic," instrument control board was selected for the new lubricating oil solvent refining and dewaxing unit at the Lima, Ohio, refinery of Standard Oil Co. (Ohio) for two basic reasons:

1—The operator always has a complete picture of the process and all essential indications within this field of vision.

2—He has finger-tip control of the process and can quickly and conveniently reach any instrument to make an adjustment.

The effectiveness of the pictorial representation in a console is vividly illustrated above, which shows the panel board as installed at Lima. It was designed to take advantage of the lessons learned from previous installations, both Sohio's and others,

as well as improved instrument components. As a result, it employs a number of features which are unique and original contributions to the rapidly growing science of graphic instrumentation.

In the first place, the U-shaped console type panel fulfills the two basic requirements just cited—complete visualization with finger-tip control.

Secondly, it permits substantial economies in space.

Thirdly, all points which need to be recorded for accounting purposes, control trends, or future comparisons are grouped on multiple point recorders. Circular chart instruments are employed for flow, pressures, and levels. Strip chart instruments are used for temperatures. One of the new component instruments used to good advantage is the Foxboro 6-point pneumatic receiving recorder.

Fifty Extra Variables

In addition, some fifty extra indications of variables which are helpful to the operator in controlling the unit are provided on the panel. These include levels, flows, and pressures. On conventionally-designed panels, these instruments would normally be absent, being located in the field because of the expense involved in providing a dual pilot transmitter, or additional panel space.

And lastly, the color code system distinguishing the different instruments and process streams is of great help to operating and supervisory personnel for rapid identification.

The system employed on the console panel is shown in the schematic circuit in Fig. 1. It employs:

1—A conventional transmitter which is used to convert measurements by the primary element into pneumatic impulses.

2—A control mechanism, usually located behind the panel board, but designed so it can be located at the equipment if transmission lags need to be reduced.

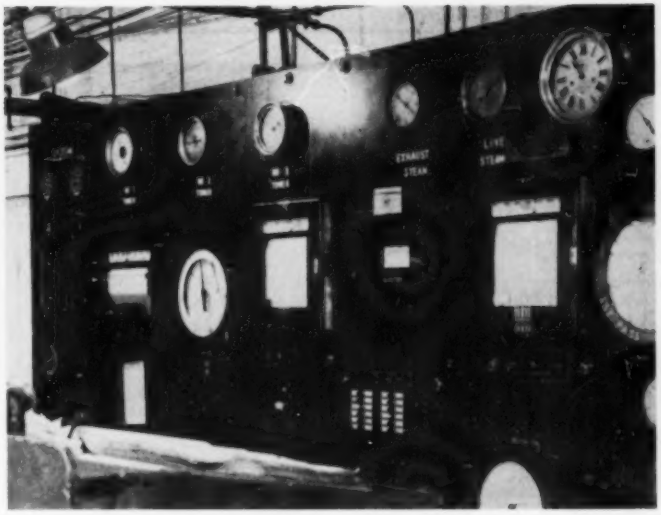
3—An indicating receiver, located on the panel board. Automatic and manual control adjustments are made from this unit.

4—A recorder-receiver, which is a multiple point (not multi-pen) recorder, designed for pneumatic operation.

5—A conventional diaphragm motor control valve.

Miniature Indicating Receiver

The indicating receiver (Item 3 above) is a remote control station and force balance controller, which was introduced by Moore Products Co. in early 1949. It provides, in an acceptable form, all the control functions needed for successful graphic instrumentation. This remote controller consists of a small gage type indicator with provision for remote manual as well as automatic control. In addition, the air output to the valve can be read so that the valve position can be easily determined. The device is slightly more than four inches square.



THE OLD—A pipe still instrument panel at Lima

Any classification of the merits or shortcomings of graphic console instrumentation must consider the effect on operating, maintenance and process design groups. Operating men are concerned with the over-all features of the system. Maintenance men are primarily concerned with the components. Process design engineers, on the other hand, are interested in the system from the standpoint of what it can do to improve the quantity or quality of products.

From a practical standpoint, the graphic panel is very effective in training both old timers on new process units and inexperienced men on any units. Pictorial representation has proved very effective when used by educators and advertisers. "Green operators" will remember instrument functions more easily because they appear on the panel much the same as they function on the process equipment itself. In addition, every time a control adjustment is made, its effect on the process as a whole can be readily seen. The panel is very much like a working model. For example; in the case of a graphic panel designed for a Thermofor catalytic cracking unit by Lummus Co., the unit went on stream easier than any unit they had ever built, accord-

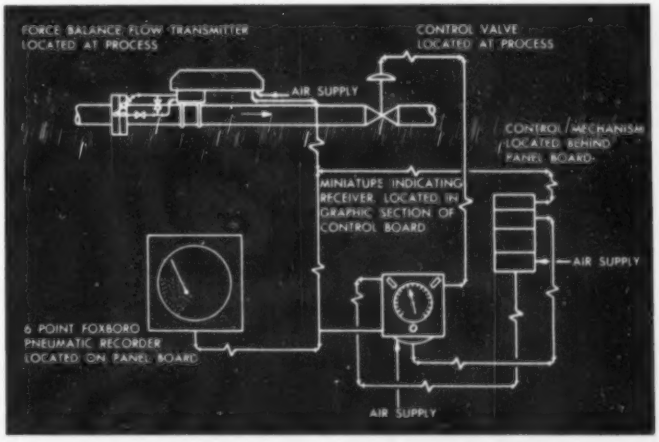
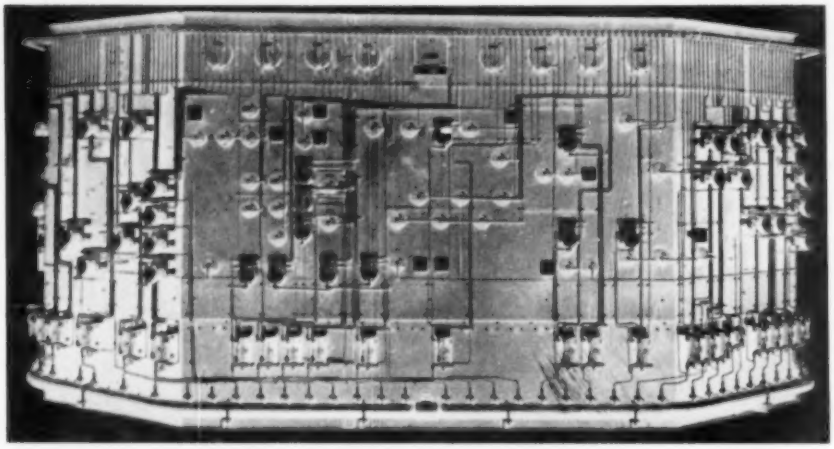

FORCE BALANCE FLOW TRANSMITTER LOCATED AT PROCESS
CONTROL VALVE LOCATED AT PROCESS
AIR SUPPLY
CONTROL MECHANISM LOCATED BEHIND PANEL BOARD
MINIATURE INDICATING RECEIVER LOCATED IN GRAPHIC SECTION OF CONTROL BOARD
AIR SUPPLY
6 POINT FOXBORO PNEUMATIC RECORDER LOCATED ON PANEL BOARD
AIR SUPPLY

FIG. 1—Schematic circuit used in the Sohio console panel



REAR VIEW of Sohio's new console graphic panel shows interesting details of instrument arrangement

ing to the "start-up" operator. He found that he could point out operating procedures on the panel and get his point firmly established in the trainee's mind. This was true in spite of the fact that a large percentage of the operators had never had any previous refinery experience.

The console type design, by virtue of its compactness, remains within the operator's field of vision and consequently is a very efficient means of preventing upsets. Several factors account for this:

1—The operator is aided by the use of color and shade which emphasize or subdue the various pieces of equipment and process streams. On the Sohio panel, important control instruments and process equipment stand out because of identifying colors.

2—The operator needs to check only that the set point and control point are properly aligned on each instrument. To further help him in keeping the functions of the instrument straight, the different types of indicating pointers are painted different colors. For example, temperatures are green, pressures are blue, flows purple, etc. Each has to be aligned with a red set-pointer.

3—The indicator scale length is twice as long as that of the conventional circular chart recording controller. Thus the readability is improved so that the operator can more easily pick out deviations.

4—A six-point pneumatic recorder is used wherever it is necessary or desired to follow control trends. This places related records on a single chart where the operator can see the variable which gets out of line first. A circular chart offers an additional advantage because it aids in planimetering flows for accounting purposes.

The same features which help an operator to keep straight on the process are even more valuable to the supervisor, who has a number of units to coordinate. He can walk into a control room, look at the flow diagram, check the critical variables, and tell just how operations are going.

On large, complex units using conventional panels, it is often necessary to have more than one operator on control board duty. On a console board, one man can conveniently handle the job. A comparison of the console board on the Lima lube unit with what would have been required with conventional instrumentation illustrates this point. This board would have been 62 ft. long in the conventional design, and it would have required a 40-ft. square room. Actually, all the instruments and graphic diagram are contained on a board 28 feet long by 30 inches high (above the table top). It fits nicely into a room approximately 18 x 28 ft.

Installation Costs

A comparison of installation costs on new and conventional systems is illuminating. Sohio realized an overall saving of better than 15% of the total cost of instrumentation with the new Lima panel.

1—The small control room, just mentioned above, cost less than $7,000. The assigned cost of a control room to house a conventional panel for an MEK-Furfural plant would have been over $20,000.

2—Cost of instruments was reduced by combining necessary records on pneumatic multi-point units. There is no sacrifice of recorded points. Graphic type indicating instruments and controllers were found less expensive. The monetary savings on this item came to about $5,000.

3—The console panel lends itself to pre-fabrication under shop conditions. It can be shipped as a completely assembled unit requiring only the final air, electricity, and control tubing connections in the field. From preliminary estimates, it appears that this will save more than $2,000.

4—A feature of console panel instruments which appeals to the maintenance department is the complete inter-changeability of control and panel board indicating units, due to the unit type of construction. In fact, a majority of the board units differ only in the dial face. This means a smaller inventory of repair parts. Replacement units can be quickly installed in the field without keeping the system out of service very long. Necessary repairs can then be made in the instrument shop.

5—By using the six-point recorders, the cost of instrument charts is reduced. On the Sohio unit this involves an annual saving of over $300.

One major advantage of the console graphic system involves a very technical discussion of instrumentation principles. This need not be enlarged upon beyond stating that on some applications the fastest speed of response is essential. With the type of instrumentation employed on the Lima panel, it is possible to locate the control unit conveniently behind the panel board or at the equipment itself. Thus, transmission lags are reduced to a minimum. Many flow and pressure control applications are responsive to such treatment. In the case of critical flow regulation, it was thought best to locate controllers at the equipment.

One single large disadvantage of graphic instrumentation is in the design of the flow diagram itself. This is relatively fixed once the board is

built. Sections of the panel board cannot be easily replaced as changes in process flow are made without affecting the meaning of the diagram. Space must be allotted for any anticipated process changes or for installing future items on a unit. To handle changes which cannot be anticipated, the control board must be designed so that sections can be removed or altered. This will almost always be a more costly proposition than changes on a conventional panel board.

Centralized Control Rooms

The modern refinery control center developed slowly. As processes became more complex, the reasons for grouping control instrumentation at one central point in a process unit became more apparent. Some of the first were started in a corner of the pumphouse. Sohio's former pipe still panel at Lima, shown on p. 723, was a typical example. It was designed as part of the pumphouse, but gradually took on the additional function of a control room.

With the introduction of pneumatic transmission methods, more and more control rooms were built for the specific purpose of centralizing the instruments. As Panel boards grew in size they began to be a process problem for most refineries. The job of keeping track of a large control board became a more difficult task. Efforts to conserve on space brought about the large U-shaped panel. Sohio's fixed bed catalytic cracking unit control board is in this category.

This was the company's first experience with the graphic panel idea. It was built in 1943 for the Houdry cracking unit at the No. 1 refinery in Cleveland. Naturally, it was limited because of the type of instrument components then available.

In a way, this U-shape became an additional handicap to the operator. Very often he could not see upset conditions when they occurred because his back was turned to the particular section of the board containing the instrument in question. Corrective measures then were sometimes too late to prevent off-specification products. Frequently, costly re-run or blending operations became necessary. More important was the loss of refinery capacity and the danger of a shutdown. A typical example was that a "cracking coil" upset often led to a shutdown. It was caused by too high a temperature at the coil outlet, which invariably resulted in coking.

The solution for many refineries to the problem of panel board size seemed to be to employ more control operators. In the development of the modern control center several factors became increasingly apparent:

1—The newer units were more complicated and difficult to control. It was therefore essential to make operators fully aware of the relationship of the instruments to operating variables. With conventional control boards this was quite difficult because of control panel length.

2—Control rooms were becoming larger and more costly because more instruments were being used on the new process units. Often the cost of a control house was equal to or greater than the cost of the instruments themselves. Occasionally, material flows and plot plans had to be changed because of the size of the control house.

3—The modern "continuous process" type of unit was more difficult to control. It was designed for high throughputs with a minimum of storage space between stages. Even minor upsets could keep an operator very busy getting back on control. Conventional panel boards were almost always too big for an operator to see an upset before it was too late. Often the first indication of trouble was the alarm buzzer.

4—On the continuous process unit there was an inter-relationship between measurements. If upsets or shutdowns were to be avoided, an operator had to be able to make rapid adjustments. He had to be able to observe and anticipate impending trouble spots. For example, a high temperature at the top of a crude tower could flood the reflux drum and shut down the compressor. Prompt corrective action in controlling this temperature would not only insure better tower operation but also would prevent compressor difficulties.

In the period between 1920 and 1942, a great many improvements had been made in the field of instrumentation, particularly in more accurate measuring and controlling systems. For example, such things as electronic temperature measurement, cascade systems, pneumatic transmission, or reset control action were unheard of back in the days of the old Burton stills.

Requirements More Strenuous

These new factors had been introduced to keep pace with improvements in process design. They were necessary to minimize the possibility of human errors. In petroleum refining the requirements for instruments were becoming more and more strenuous as product specifications grew more rigid. Many instruments that were adequate enough for a shell still would not be sensitive enough for cat cracker control.

Operating, process, and design groups all recognized that better instruments were helping to eliminate the human factor of error from process control. They felt that this was not enough. They wanted instrumentation which would help the control man to see and correct for changes before they grew into upsets. They wanted to do more to eliminate troubles at their source rather than correct them after they developed into upsets. Wartime demands were presenting many new problems in the maintenance of production schedules. New processes and inferior equipment due to emergency restrictions were contributing to upsets. The general opinion was that something in the nature of a compact bombing plane instrument panel was needed. One obvious difficulty preventing the adoption of this compact design was the size of conventional instruments. A newer, smaller instrument was needed.

When the war ended, a number of enterprising process and instrument engineers again took up the quest for controllers which would be suited to graphic instrumentation. In general, it was agreed that the best design would incorporate the following features:

1—Instruments should be small enough to be located in or around a flow diagram painted on the panel board.

2—The new design should be equal to or better than existing equipment with regard to accuracy, readability, and ease of maintenance.

3—Provision for manual as well as automatic control of valves, pumps, and similar equipment from the panel board was essential.

4—Multiple point recorders were necessary not only to conserve panel space but also to combine related variables on a simple chart. These would also bring out the control trends and provide accounting records.

5—It was the feeling at Sohio that a console type of panel was the most satisfactory compact design. It was felt that this would best enable an operator to see and adjust all the instruments easily without loosing his grasp on the over-all situation.

It is realized that the present development at Lima is far from being the ultimate in instrumentation. Already new equipment is being fabricated and further thought given to designs, which assures the availability of still better controls in the near future.

Progressive improvement will come only through active participation of both designers and users. To this end, Sohio will endeavor to promote improvement with the aim of achieving the unit which comes closest to "running itself."

The author wishes to acknowledge with sincere gratitude the cooperation and assistance of W. O'Connor and F. Rowan of The Lummus Co. and K. N. Thompson of the Standard Oil Co. (Ohio).

CHEMICALS

Their Production and Consumption By the Petroleum Industry

By EUGENE AYRES
Gulf Research and Development Co., Pittsburgh

IT is difficult to explain what is meant by "chemicals" and "chemical intermediates."

"Chemicals" are frequently (not always) substances that are somewhat removed from their principal end-use, while "chemical intermediates" are still further removed. But isobutylene, when it is a starting point for alkylate, is regarded as neither a "chemical" nor a "chemical intermediate". The minor amount of isobutylene used to make butyl rubber is listed as a "chemical." All ethylene is put in the "chemical intermediate" column. The difference between isobutylene and ethylene would seem to be that the principal end-use of the former is fuel whereas the principal end-uses of the latter are nonfuel.

Tetraethyl lead is a "chemical" in spite of its sole end-use as a fuel constituent. Toluene, even when used for aviation fuel, is a "chemical", but isooctane is not.

"Chemicals" are frequently (not always) substances whose structures are well defined. But ichthyol, which has an indeterminate composition, is a "chemical" while pentane is not.

It is necessary to make a distinction between *petrochemicals* and "chemicals produced by the petroleum industry." The chemicals produced by the petroleum industry are, for the most part, not petrochemicals at all, but rather materials like sulfuric acid, ammonia, and aluminum chloride. At least 85% of the so-called petrochemicals are now being produced by the chemical industry. And all of the petrochemicals will eventually be made not from petroleum but from coal.

The term "petrochemical" is an unfortunate one because it merely means a hydrocarbon derivative which happens, at the moment, to be based on petroleum more often than coal, and which is manufactured largely by the chemical industry. And it is necessary to exclude, for some peculiar reason, hydrocarbon derivatives to be used primarily as fuels or as lubricants. Thus acetylene made from methane is commonly classified as a petrochemical while diisobutylene made from isobutylene is not. Each is a synthetic product made from petroleum, but they differ in markets.

If we ignore markets, the petroleum industry today produces thousands of times as great a bulk of hydrocarbon derivatives as the chemical industry. Motor fuel, for example, is made up largely of hydrocarbons which are not native to petroleum, but we do not call these hydrocarbons "petrochemicals." We do not even regard them as synthetic. We often reserve the idea of "synthesis" for petroleum chemical operations that are: (1) out of the fuel field; (2) somewhat unfamiliar; (3) carried out on a moderate scale. However, a motor fuel is called "synthetic" if it is made from a raw product other than petroleum—even if the method of manufacture is conventional and on a large scale. A lubricant is "synthetic", even if it is made from petroleum, if it is made at high cost by methods which are uncommon.

Since there is no good way to define "chemical," there is no good way to define the "chemical industry." It is for this reason that statistics on "chemicals" and on the "chemical industry" are without much meaning. Some of the figures in this article are not only substantially different from earlier published figures but of a different order of magnitude.

Perhaps the best way to look at the matter is this: the petroleum industry is a chemical industry chiefly concerned with the production of fuels and lubricants from petroleum; the steel industry is a chemical industry chiefly concerned with the manufacture of steel; there are a number of other large specialized chemical industries; then we have left over many miscellaneous "cats and dogs", and these are grouped together as products of the "chemical industry."

Now that we have succeeded in becoming thoroughly confused, let us consider some of these "cats and dogs" as they are related to the petroleum industry—and just for the sake of simplicity let us call them "chemicals."

Petroleum companies do not join in the manufacture of chemicals

Meet the Author

Mr. Ayres

Eugene Ayres, newly appointed technical assistant to the executive vice president and director of research for Gulf Research and Development Co., is an authority of long standing in development of chemical and petroleum enterprises. He established the first American manufacture of diphenylamine, wool grease, lanolin, amorphous petroleum wax, and synthetic alcohols from petroleum. He developed standard methods for large-scale direct chlorination of petroleum hydrocarbons, of chemical dehydration of crude petroleum emulsions, of refining vegetable oils, and of continuous esterification of mixed alcohols. In 1924, in partnership with P. T. Sharples, he founded Sharples Chemical Corp. for the manufacture of synthetic chemicals from petroleum.

He was put in charge of research for Gulf Refining Co. in 1929 and was transferred to Gulf Research and Development Co. in 1934. Since that time he has been engaged in organization and management of research concerned with the manufacture and sale of petroleum products.

Mr. Ayres was graduated with a B. A. degree from Swarthmore College in 1912. In addition, he has received a B. S. degree from the University of Texas, a Sc.D. degree from M.I.T., the national Tau Beta Pi Fellowship for 1937-38, and the duPont Fellowship for 1939-40.

merely because they have an abundance of raw product, any more than coal companies make coal chemicals because they have plenty of coal. As a matter of fact, the abundance of raw material is rather embarrassing. For example, if all of the available ethane of the country were converted to ethylene, the present production of synthtic alcohol could be multiplied by 50. Nearly all of this ethane is now burned as fuel. Any single major petroleum refiner (there are about 15 in this category) has enough raw product to break the market on any petroleum chemical.

Furthermore, the industry produces huge quantities of chemicals which it does not attempt to recover or sell on any substantial scale. This is true of hydrogen sulfide, for example, which is so abundant that it could be made the source of far more than all the sulfur needed in the United States. The present production of synthetic methanol in the United States is only 2 or 3% of the methanol which could be manufactured from the natural gas that is burned in the Greater Pittsburgh area alone.

Reasons for Interest

But there are various good reasons for the petroleum industry to concern itself with miscellaneous chemicals. A few of them are as follows:

1—To insure an adequate supply of a product that is marketed (antifreeze compounds).

2—To make available certain needed chemicals that are not manufactured by others (additives).

3—To utilize fuel that would otherwise be wasted (ammonia).

4—To avoid excessive transportation costs of needed reagents (sulfuric acid).

5—To avoid pollution of streams or atmosphere (sulfur).

6—To take advantage of by-products of petroleum research.

7—To utilize the peculiar genius of the petroleum industry for national emergencies (butadiene).

One of the outstanding qualities of the petroleum industry is its process engineering. During the past 20 years, the petroleum industry has been developing a unique process-engineering technology. It is a technology of bigness. It is characteristic of the petroleum refinery to operate on a grand scale. Single processing units are sometimes as tall as 20-story skyscrapers. Two hundred people could be seated comfortably on the foundation of a catalytic reaction vessel. A 160,000-bbl. tanker, which could hold more than one third of the annual production of the largest synthetic alcohol plant, is capable of satisfying the appetite of a single petroleum topping unit for less than three days.

The philosophy of bigness has been vitally important to our national economy in enabling us to make vast quantities of fuels and lubricants at incredibly low processing costs. But bigness can represent weakness as well as strength when it comes to the relatively small-scale production of finished chemicals. The paramount function of the petroleum industry in the chemical field is the large-scale production of intermediates, particularly in times of economic or national emergency.

During World War II the production of butadiene, for example, jumped from substantially zero to nearly a billion pounds per annum.

At the present time, the production of the principal chemicals from petroleum is about 6½ billion pounds, of which less than one billion is made by the petroleum industry. Discounting emergencies, the trend in the petroleum industry itself will undoubtedly be upward in the future, not because petroleum is an abundant raw product but because the petroleum industry has so well developed the large-scale use of such essential unit processes as isomerization, alkylation, aromatization, cyclization, polymerization, hydrogenation, dehydrogenation, hydration, and dehydration.

When a chemical intermediate is needed in large volume, the petroleum industry is likely to make it. And when intermediates are made on a large scale, derivatives are sure to be developed on a smaller scale. This is a natural consequence of the large volume of research effort being put forth by the petroleum industry.

Research Develops Sidelines

No matter how carefully research may be directed toward the major interests of an industry, there is no good way of avoiding the emergence of useful and novel ideas related to secondary interests. It seems rather unlikely, however, that the manufacture of finished chemicals by the petroeum industry can ever represent a large segment of the miscellaneous chemical industry. Small scale diversification requires too foreign a viewpoint in manufacture, sales, and finance.

Butadiene and toluene are outstanding examples of emergency production without reference to normal demand or cost. A borderline case is that of ethyl alcohol, much of which was produced synthetically during the war only because of the abnormally high price. Much of the production of high-cost synthetic alcohol has been replaced by low-cost production, and synthetic alcohol now represents about half of total production. The only new synthetic alcohol plants which can be expected in the future are those of largest size with lowest-cost processes of synthesis. And the long-term prospects of even such plants do not seem to be too definite because of the possibility of large-scale use of processes for the synthesis of fuels.

You will recall that the Fischer-Tropsch process converts either natural gas or coal to carbon monoxide and hydrogen, which are in turn converted to liquid fuels and chemicals.

The first commercial plant has been completed to operate on natural gas. The process can be adjusted to make varying ratios of oxygenated hydrocarbon to fuel, but present technology does not appear to make it possible to obtain ethyl alcohol in amounts less than about 4% by volume of the synthetic gasoline. On this basis it is estimated that if only one fifth of the country's motor fuel were made by this process, the by-product ethyl alcohol would amount to 200 million gals./year—about the present total production of the United States. This is a minimum figure. Present technology indicates that the volume would be nearer 400 million gals./year. Some day alcohol may be considered merely an impurity that must be removed at considerable expense to avoid stream pollution.

Effects on Alcohol Market

The impact of any wide use of the Fischer-Tropsch process on the alcohol market would be even greater than indicated above because the process yields not only ethyl alcohol but also a number of the chemical products into which ethyl alcohol is now being converted. Even the one plant now completed (which will make only about 0.25% of the country's motor fuel) should have an appreciable effect on the alcohol market. The output of this plant is expected to run at least 150 million lbs. of chemicals annually. Nearly half of the total will be ethyl alcohol, and a fair proportion of the balance will be materials which can be made from alcohol. Fortunately for the chemical industry the commercial extension of the Fischer-Tropsch process is likely to come gradually over a period of 30 or 40 years.

Mixtures of carbon monoxide, hydrogen, and olefins can be used to make chemicals as primary instead of secondary products. This is likely to develop more rapidly than the plans for synthetic fuels and should provide some of the desirable organics which are now in short supply. It would be surprising if such processes did not eventually displace some of the conventional chemical operations.

Synthetic alcohol is now made from petroleum ethylene. The Fischer-Tropsch process forms more ethyl-

TABLE 1—Organic Chemicals from Petroleum, 1948

Origin	Product — Name	From All Sources (1,000,000 lbs.)	From Petroleum (1,000,000 lbs.)	Principal Use
C_1	Synthetic Ammonia	1,325	477	Ammonium Sulfate
	Methanol	990	310	Antifreeze
C_2	Ethanol	1,483	712	Antifreeze
	Ethylene Glycol	367	312	Antifreeze
	Ethyl Chloride	275	275	Tetraethyl Lead
	Ethylene Dichloride	236	236	Ethylene Diamine
	Ethylene Oxide	38	38	Fumigant
C_3	Isopropyl Alcohol	834	834	Acetone
	Glycerine	200	30	Alkyd Resins
C_4	Butyl Alcohols	297	148	Solvents
	Butadiene	661	661	Synthetic Rubber
C_5	Amyl Alcohols	19	15	Solvents
C_7	Toluene	604	359	Aviation Fuel
C_8	Xylene	440	383	Solvent
Crude	Cresylic Acid	33	10	Disinfectant
	Naphthenic Acids	25	25	Additives for Oils
Mix.	Chlorinated Hydrocarbons	1,003	1,003	
	Petroleum Sulfonates	65	65	Detergents
	Totals	8,895	6,393	

ene per barrel of motor fuel than the conventional refining of petroleum. Therefore, we are likely to have by-product ethylene with us always, and its most profitable utilization will depend upon all the factors of investment, process costs, and market demand.

Long Term Source Is Coal

It seems paradoxical to say that the predominant long-term source of organic chemicals will be coal, but this is inevitable. When liquid fuels and lubricants are made from coal, chemical intermediates will be even more available then they are today. A good example of this is benzene, the production of which from petroleum can be justified economically only by a pressing demand for quantities in excess of normal production of by-product coke ovens. But in conjunction with certain processes of conversion of coal to liquid fuel, benzene production could be increased enormously.

Synthetic phenol could be made abundantly. The same thing is true of xylene. During the war, about 80% of our xylene was made from petroleum. A somewhat lower proportion is made now. The present yield of xylene from coal could be multiplied many times. The petroleum industry has accounted for about 35% of the cresols produced in the United States. Cresols will be much more abundant when liquid fuels are processed from coal.

Petroleum is predominantly a source of aliphatic chemicals, and it happens that aliphatic chemicals are also those formed as an incident to the conversion of coal to liquid fuels. During the war, about 85% of our acetone was made by the catalytic dehydrogenation of isopropyl alcohol (from petroleum). The production of acetone, which once was a "drug on the market," has shown a steady rise during the last 10 years until now it is almost 500 million lbs./year, about 95% of which comes from petroleum. But acetone can also be formed abundantly by the coal conversion process.

In Table 1 are shown some of the principal organic chemicals produced from petroleum in 1948. It is rather interesting to note that for these particular items listed, petroleum is the source of 72% of the total amounts being manufactured. Ten per cent of the chemicals made from petroleum are used for antifreeze and around 10% for synthetic rubber, making a total of 20% for the automotive industry. In addition, 4% is used for tetraethyl lead, which is, of course, used by the petroleum industry. It should be emphasized again at this point that a very small part of the total is produced by the petroleum industry itself.

A number of miscellaneous chemicals are being derived in part from petroleum operations—for example, 939 million lbs. of carbon dioxide and 386 million lbs. of carbon disulfide. In 1948, 4822 long tons of sulfur were recovered from petroleum operations, and this recovery is expanding rapidly because of the need to avoid the pollution of air with hydrogen sulfide.

Big Consumer of Chemicals

While the petroleum industry has been responsible for the production of less than one billion lbs./year of chemicals from petroleum, the consumption of chemicals by the petroleum industry is vastly greater than this.

There are three reasons for the consumption of chemicals by the petroleum industry: (1) reagents and solvents are required for crude oil production and for refining operations; (2) chemicals are incorporated in petroleum products; and (3) chemicals are purchased for retail sale.

Perhaps as many as a thousand different chemicals are required in substantial quantities by the petroleum industry. Many chemicals are required in large tonnage amounts and represent high proportions of total production. For example, in 1949 about 11% of our domestic lead consumption was for the manufacture of tetraethyl lead—99,000 tons of lead, which corresponds to about 390,000 tons of tetraethyl lead fluid. (Some of this is exported.) This fluid, incidentally, contains about 55,000 tons of bromine, which is about 90% of our total bromine consumption.

In the refining of petroleum, a number of reagents and solvents are used for processing. Some of the inorganics are shown below:

	Short Tons
Sulfuric Acid	975,000
Clay	185,000
Caustic Soda	150,000
Cracking Catalyst	100,000
Aluminum Compounds	10,000
Lead Oxide	6,000
Ammonia	5,000
Soda Ash	5,000
Sodium Bicarbonate	800
Copper Sulphate	500

About half of the sulfuric acid is manufactured by units of the petroleum industry, for the most part from purchased sulfur. Nearly all of the clay and catalyst is purchased. Most of the caustic soda is purchased.

In the refining of petroleum the principal organics are for solvent purposes. The industry is probably the largest consumer of furfural and methyl ethyl ketone, and we consume about 6000 tons/year of phenolic solvents.

Largest Use for Organics

The largest use of organics in the petroleum industry is for incorporation into fuels and lubricants. Seventeen classes of materials are so used in amounts exceeding 500 tons/year. One of the 17 is tetraethyl lead, which has been mentioned already, and another is a group including inhibitors for fuels and lubricants. It is interesting that the requirements for inhibitors should now amount to more than 15,000 tons/year—most of it for lubricants. The subject is quite complicated because there are at least 36 *kinds* of additives and many representatives of each kind.

There is much other material which is so incorporated. The average integrated oil company sells at least 700 products. More than half of these products contain some non-petroleum material, and most of the non-petroleum material is either purchased outright or is manufactured from purchased raw materials.

The peculiar genius of the petroleum industry lies in its development and operation of processes on a very large scale and the widespread distribution of low priced products. This makes the industry a good customer of the chemical industry and a potential competitor in wholesale production of intermediates.

Sulfur in Your Crude Oil? . . . It's Not How Much But Where

Refinery Experiencing Corrosion from Sweet Crudes Finds Troubles Due to High Sulfur in Light Fractions

By WILLIAM C. UHL
Equipment Editor

THE sulfur content of crude oil apparently is not a direct measure of its tendency to corrode petroleum processing equipment. More important is the sulfur content of some of its lighter fractions and the operating temperatures in processing.

These facts were reported in a case history of corrosion at Gulf Oil Corp.'s 230,000 b/d Port Arthur refinery in a new atmospheric and vacuum crude still.* The crude charged was a relatively sweet type, averaging only 0.20% sulfur content, from West Texas, mostly Ellenberger formations, of Ordovician age. Typical West and East Texas crudes run about 1.49 and 0.30% sulfur, respectively. Nevertheless, severe corrosion was found in the atmospheric tower overhead condenser shells and the carbon steel tubes in the radiant section of the fired heater, where desalted crude is heated to 600° F.

The crude was described as a paraffin base with low salt and negligible acidic materials. It would have been considered sweet except for appreciable quantities of sulfur in the lighter fractions. For example: the gasoline cut contained 0.13% S, 0.065% mercaptans, 0.007% H_2S; the naphtha cut, 0.11% S, 0.05% mercaptans; and the kerosine, 0.09% S, 0.05% mercaptans. These are all well over normal sulfur values in light fractions from sweet crudes and more nearly approach those of West Texas sours.

A test for acidity in the desalted Ordovician crude and the neutralization number under ASTM Method D 664-46T was nil. BS&W varied from a trace to 0.1%.

The process unit itself is conventional in design, mostly of carbon steel construction except for alloy materials or alloy linings where corrosion had been anticipated. Furnace tubes and headers in the atmospheric heater and most of the process piping are of carbon steel. The 18-in. transfer line from the heater to the atmospheric tower is clad with Type 405 stainless steel. The tower proper is of carbon steel with Meehanite trays and bubble caps.

After a four-month initial run, beginning May 8, 1948, inspection revealed corrosion only in the flash section of the atmospheric tower. An analysis of the corrision product indicated chiefly iron sulfides, showing that sulfur was the troublesome factor. Ammonia injection into the overhead stream was adopted as a remedy during the intial run. Control was accomplished by use of a pH indicator and manual operation of the ammonia needle valve. Ammonia consumption was about 0.8 lbs./1000 bbls. crude charge to maintain the pH at the desired value.

In February, 1949, a shutdown showed corrosion beginning in the overhead condenser shells and the flash section of the atmospheric tower. Monel linings, 5/64 in. thick, were installed in the lower half of the three upper condenser shells, and the flash section of the tower received strip lining of Type 410 stainless steel.

The unit had been back on stream for 35 days when a leak occurred in a furnace tube. This was found to result from severe localized corrosion inside the tube at the point of contact with the middle hanger. Also, the tube was generally thinner on the bottom (fire side) throughout most of its length. Four other tubes were found too thin for service also and were replaced with 7 Cr, ½ Mo tubes.

The unit came down again in 37 days because more holes developed in other furnace tubes adjacent to the replacements. These holes were also at the hanger locations. A Penetron inspection of the entire furnace resulted in the condemning of 39 tubes for thinness on the fire side. Replacements were made with 17 tubes of the 7 Cr ¼ Mo alloy and the balance of carbon steel (Gulf had no more alloy tubes on hand at the time). The heater on the vacuum tower showed no trouble, although higher oil temperatures were being experienced—730 vs. 605° F. at oil outlets.

A careful study of the furnace tube corrosion led to the belief that the accelarated attack at the hanger locations was due to the fact that the hangers act as fins to permit higher heat input. In turn, the higher local temperatures of the inside oil film resulted in increased chemical reactions between the sulfides in the crude and iron in the tubes.

"It has been shown that a temperature differential as great as 170° F. can exist between the average tube wall temperatures on the first side and the top side," the report stated. "It must therefore be postulated that the *oil film* temperature on the hot side is generally higher than the *average* oil temperature in the tubes, and it is this *film* temperature which governs the corrosion rates." Reference is made to Table 1, which shows the various wall thicknesses and wall losses in a tube originally of 0.375 in. wall thickness, after 7360 hrs. of service.

Corrosion agents other than sulfur could fairly be disregarded. Chloride content was very low, 2.5 lbs. NaCl equivalent per 100 bbls. crude after desalting. Acidic materials were practically nil. Neutralization Nos. for lube distillates were from 0.02 to 0.03. Finally, scale deposits had been shown to be principally iron sulfide.

Apparently the sulfur compounds were the type which decomposed or became very active at temperatures near and above 550° F.

The most satisfactory answer to the problem of handling so-called sweet crudes, which nevertheless have high sulfur contents in their lighter fractions, is greater use of alloys, Gulf believes.

TABLE 1—Wall Thicknesses and Losses of Tube, 43 ft. Long, Originally 0.375 in. in Wall Thickness

Calibration Point	(after 7360 hrs. of Service) Wall Side Thickness—in.	Fire Side Thickness—in.	Fire Side loss—in.
3 ft. from front wall	---	.285	.090
8 ft. from front wall	.315	.186	.189
15 ft. from front wall	.286	.143	.232
Middle (4 in. from hanger)	.232	.115	.260
15 ft. from rear wall	.280	.140	.235
8 ft. from rear wall	.310	.180	.195
3 ft. from rear wall	---	.280	.095
At front hanger	---	.105	.270
At middle hanger	.230	60(hole)	.375
At rear hanger	---	.095	.280

* Details of this experience were presented in a paper by D. L. Burns, inspection and corrosion engineer, Gulf Oil Corp., Port Arthur, at the 1950 annual meeting of the National Ass'n. of Corrosion Engrs. in St. Louis.

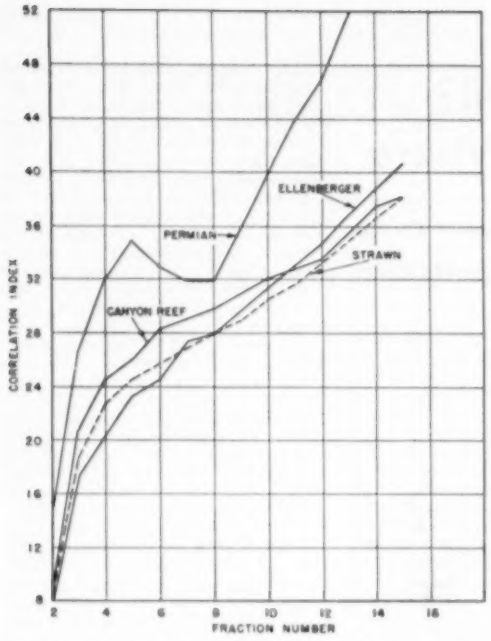


FIG. 1—Comparison of crude oils from producing horizons in Scurry County and adjacent areas

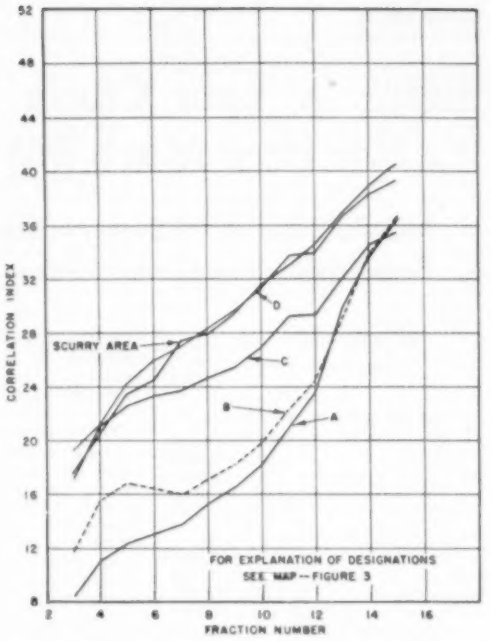


FIG. 2—Comparison of crude oils from Ellenberger limestone in Scurry County and other areas

Refining Properties of New Crudes

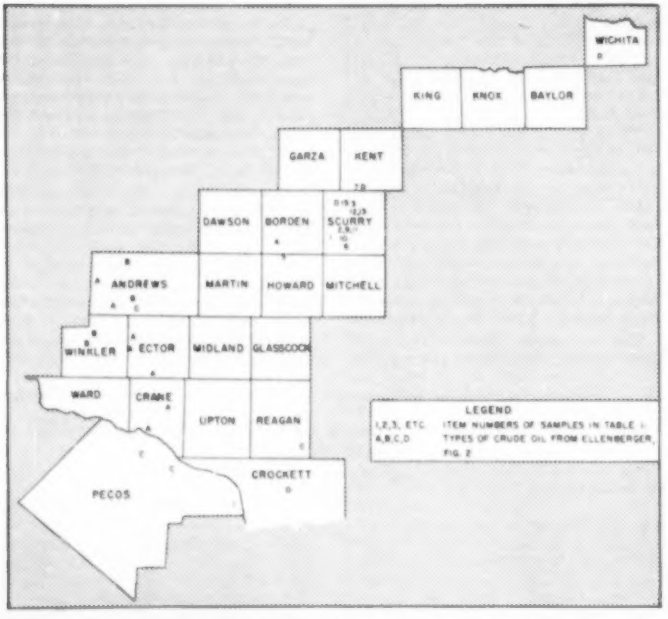


FIG. 3—Approximate locations from which samples were obtained (by number) and approximate locations of Ellenberger samples (by letter)

This article discusses the crude oils produced from the Canyon Reef, Ellenberger, and Strawn formations in the new, important production area of Scurry County and vicinity in Texas. Comparisons of these crude oils with the Permian oils of West Texas are made, and comparisons with other Ellenberger production throughout Texas are also given. Comparisons of the commercial products that might be obtained from the Scurry area crude oil by refining are made on the basis of similar products from East Texas crude. The Scurry-area crude is very similar to East Texas crude in most respects, and should yield similar quantities and qualities of products upon proper refining.

The first article in this series [1] discussed the routine method used by the Bureau of Mines in analyzing crude oils and the means by which these oils can be compared. Examples also were given of methods used for estimating the quantity and quality of various commercial products.

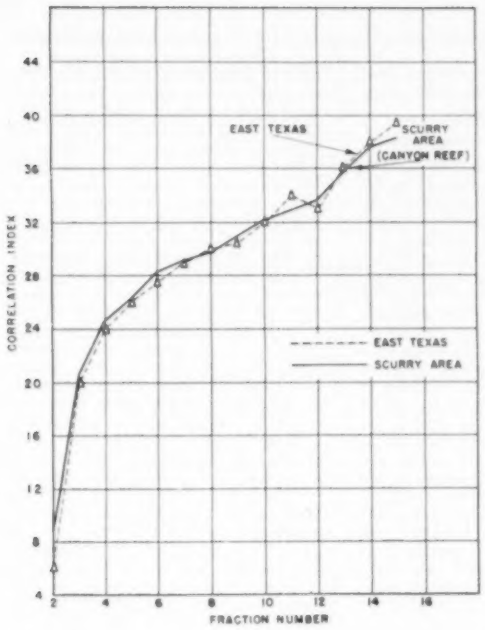


FIG. 4—Comparison of crude oils from East Texas and Scurry County areas

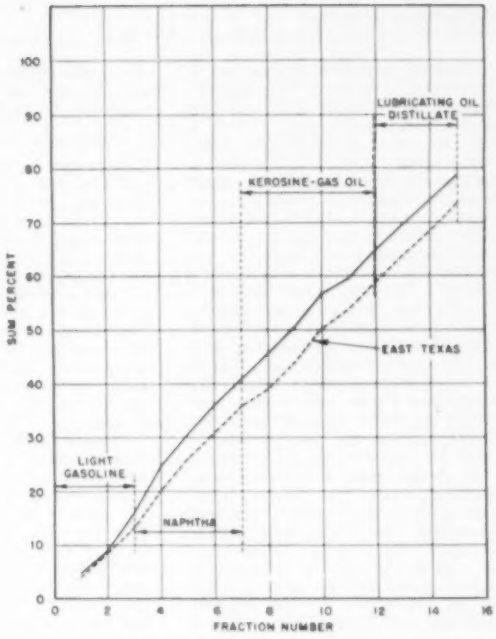


FIG. 5—Comparison of distillation curves for East Texas and Scurry County crude oils

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Part 2—Characteristics of Crude Oils from the Scurry County, Texas, Area

THE Scurry County area, consisting of fields in Scurry, Borden, and Kent Counties in West Texas, became important from a production viewpoint in 1949. It has developed rapidly during the last two years, and at the present time there are over 600 completed wells. Production is largely from the Pennsylvanian "Canyon Reef" limestone, with smaller amounts from the "Strawn" limestone of the same age, and from the "Ellenberger" limestone (Ordovician).

The area is of very great importance in the present crude oil production picture of the United States. As of Jan. 1, the proved reserves were estimated to be 900,000,000 bbl., while at present C. J. Degan[2] states: "As of now, one might place the proved reserves at anywhere between a billion and one and one-half billion barrels without running into any serious argument with qualified geologists." This area is probably the most important United States discovery since 1930, when the East Texas field was brought in.

A condensed summary of the analyses of 16 recently collected Scurry County area crude oils is given in Table 1, and complete analyses of crude oils from each of the three producing horizons (Canyon Reef, Strawn, and Ellenberger) are given in Tables 2, 3 and 4. These correspond, respectively, to Items 6, 12, and 15 in Table 1.

There is a strong resemblance among all 16 of the analyses shown in Table 1, but a careful study of the figures tabulated indicates that the oils can better be described as "very much alike" rather than "identical." Previous experience in comparing crude oils indicates, however, that if sampling of the area were more intensive, more definite similarities would be found.

Comparison with Other W. Texas Oils

It is of interest to compare the oil produced in this recently developed area with the oil which has been produced for many years from Permian horizons in West Texas. As was mentioned in the first article of this series, one of the most instructive ways to make such comparisons is to draw correlation index (C.I.) curves, as shown in Fig. 1. It is at once evident that the oils from the Canyon Reef, Strawn, and Ellenberger formations of Scurry County are much alike and are entirely different from the Permian crude oil. Generally speaking, the three Scurry County crude oils are considerably more paraffinic than the Permian oil; they do not have the "aromatic hump" (see Fraction 4) shown by many Permian oils. It is also significant that in the gas-oil and lubricating-oil range the C.I. is a great deal lower for the Scurry area analyses, indicating much lower contents of asphalt and aromatic hydrocarbons.

Nine analyses of Permian crude oils collected in Scurry and Howard Counties before 1939 are summarized by Kraemer and Wade[3] and three others by McKinney and Blade.[4] A comparison with the analyses of Scurry County oils listed in Table 1 is shown in Table 5. Obviously there are many differences between the shallower Permian oils and the deeper Pennsylvanian and Ordovician oils.

It is also of interest to compare the Ellenberger production in the Scurry County area with other Ellenberger

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production throughout Texas. In Fig. 2 the C.I. curves for four different types of Ellenberger crude oil have been drawn. One of these (Curve A, Fig. 2) is exceedingly paraffinic, while another (Curve B) is generally similar but apparently has a slightly higher content of aromatics. The oils represented by Curve D are definitely different from types A and B, while those of type C seem to be intermediate in character between B and D. The Ellenberger oils from the Scurry County area listed in Table 1 are much like the type D oils. If one refers to the map (Fig. 3) where the approximate locations of the various types of Ellenberger production are indicated, some geological correlations can be seen. For example, all of the type A crude oils from the Ellenberger formation appear to lie along the Central Basin Platform, while the type B oils appear to lie on either side of this trend at its northwest extremity. The type C oils are found at the southern end of the trend, and the type D oils appear to be well to the east. Fig. 3 also shows the location, by item numbers (see Table 1), of many of the crude oils from the Canyon Reef and Strawn formations which are discussed in this report.

Comparison with E. Texas Crude

Inasmuch as the East Texas field is the largest in Texas and it appears that the Scurry County area may develop to be the second-largest field, it is of interest to compare these two huge reserves. As shown in Fig. 4, the C.I. curves for Canyon Reef crude oil and present-day East Texas oil are nearly identical. The data for East Texas represent the average of two analyses of pipe-line runs, and the data for Scurry County were obtained by averaging the analyses of the 11 Canyon Reef crude oils shown in Table 1.

The similarity between the oils is shown further in Fig. 5, which is a comparison of the distillation curves of the average East Texas crude oil and that of the Canyon Reef crude oils from the Scurry County area. These curves indicate that there is some difference between the two crude oils, the Canyon Reef oil having approximately 40% total gasoline and naphtha compared to about 35% for the East Texas crude. However, the upper parts of the two curves were approximately parallel, and the yields of kerosine, gas oil, and lubricating distillate are much alike.

Further comparisons can be made by reference to Table 1, which gives all the pertinent data on the 16 crude oils from the Scurry County area and on the composite pipe-line analyses of East Texas crude oils. Although the differences between the oils are greater than would be true if they were identical oils, there certainly is a marked similarity in yield and quality of the product as revealed by the data in Table 1. The residuum from the East Texas crude oil is somewhat greater than from the Scurry County area. It also has a slightly higher specific gravity, indicating that it probably would contain somewhat more asphaltic material. On the whole, however it could be expected that refining characteristics which are true for East Texas would apply in most respects for the Scurry County area.

Confidential data released to the authors indicate that the sulfur content of the Scurry County crude oils,

TABLE 1—Summary of Pertinent Data for Scurry County Area Crude Oils

PART 1—SUMMARY OF DATA SHOWING SOURCES AND GENERAL CHARACTERISTICS OF SAMPLES

Item	Sample	State	Field	County	Producing formation and age	Depth, ft.	Gravity, °API	Color*	Sulfur, %	Viscosity 100° F., secs.	Carbon residue, %
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	50026	Texas	Diamond M	Scurry	Canyon Reef limestone, Penn.	6597-6617	45.4	B.G.	.20	35	.9
2	50027	Texas	Kelly	Scurry	Canyon Reef limestone, Penn.	6775-6778	42.1	B.G.	.22	36	1.1
3	50029	Texas	Snyder, North	Scurry	Canyon Reef limestone, Penn.	6265-6419	43.4	B.G.	.22	36	1.0
4	50030	Texas	Good	Borden	Canyon Reef limestone, Penn.	7940-8010	43.6	B.G.	.21	36	1.2
5	50031	Texas	Vealmoor	Howard	Canyon Reef limestone, Penn.	7934-7966	45.4	B.G.	<.10	36	.8
6	50033	Texas	Sharon Ridge	Scurry	Canyon Reef limestone, Penn.	6650-6680	45.4	B.G.	.18	35	.9
7	50034	Texas	Cogdell Lease Sec. 716	Kent	Canyon Reef limestone, Penn.	6857	41.7	G.B.	.38	37	1.8
8	50035	Texas	Wildcat	Borden	Canyon Reef limestone, Penn.	7100-7254	41.7	D.G.	.26	38	1.4
9	50036	Texas	Kelly	Scurry	Canyon Reef limestone, Penn.	6845-6888	41.9	B.G.	.28	36	1.1
10	50039	Texas	Shattel	Scurry	Canyon Reef limestone, Penn.	6816-6891	41.1	D.G.	.40	37	1.4
11	50040	Texas	Kelly	Scurry	Canyon Reef limestone, Penn.	6795-6875	39.4	Green	.19	38	1.2
12	50028	Texas	Snyder, North	Scurry	Strawn limestone, Penn.	7322	39.8	G.B.	.23	38	1.8
13	50037	Texas	Snyder, North	Scurry	Strawn limestone, Penn.	7487-7508	44.1	B.G.	.19	35	.7
14	50041	Texas	Wildcat	Scurry	Strawn limestone, Penn.	7520-7545	38.4	G.B.	.37	40	2.0
15	50032	Texas	Dermott	Scurry	Ellenberger limestone, Ord.	8200-8404	45.3	B.G.	.17	35	1.3
16	50038	Texas	Wildcat	Scurry	Ellenberger limestone, Ord.	7735	41.3	D.G.	.37	38	1.9
17	37128, 37129	Texas	East Texas	Pipe-line run			39.2	G.B.	.29	41	2.1

PART 2—SUMMARY OF ANALYTICAL AND COMPUTED DATA

Item	Volume percentages — Fractions: 1-3, inc. (light gasoline)	4-7, inc. (naphtha)	8-12, inc. (Kerosine and gas oil**)	13-15, inc. (lubricating oil**)	Residuum	Correlation index averages of fractions: 4-7, inc.	13-15, inc.	Characteristics of residuum: % on gasoline, free basis	Sp. Gr.
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	18.8	24.2	23.5	12.5	16.1	28	37	28	0.933
2	16.4	25.7	25.0	13.7	17.2	29	38	30	.938
3	17.2	25.0	23.8	15.1	15.1	28	38	26	.943
4	18.4	23.7	22.8	13.3	17.2	29	39	30	.943
5	15.2	25.9	24.4	13.6	19.0	26	32	32	.917
6	18.0	24.2	23.1	12.9	15.3	28	36	26	.935
7	15.7	22.5	24.5	14.2	19.9	25	38	32	.950
8	17.6	21.9	22.6	13.3	21.5	27	37	36	.943
9	15.5	26.0	24.8	14.3	16.9	28	39	29	.942
10	15.4	25.1	26.1	14.4	17.5	28	39	29	.951
11	16.1	27.0	27.5	15.9	18.4	26	36	29	.940
12	13.3	23.4	24.8	15.8	20.9	26	38	33	.947
13	15.6	25.2	25.7	15.6	15.4	24	34	26	.926
14	10.7	22.2	26.8	16.9	21.5	24	39	32	.951
15	21.7	24.8	23.5	11.4	14.5	25	40	27	.945
16	14.7	22.4	24.4	14.8	21.1	23	38	34	.950
17	15.2	22.5	23.3	14.8	23.0	27	37	36	.954

* Colors of crude oils in this table are designated as follows: Green, no abbreviation; dark green, D.G.; brownish green, B.G.; greenish black, G.B.
** Approximate.

TABLE 2—Routine Analysis of Canyon Reef Limestone Crude Oil from Sharon Ridge Field, Scurry County, Texas

Identification

Sample 50033
Sharon Ridge field
Canyon Reef limestone, Pennsylvanian
6,650-6,680 ft.
Scurry County, Texas

General Characteristics

Sp. Gr.	0.800
API Gr.	45.4°
Sulfur, %	0.18
Pour point, ° F.	<5
Color	brownish green
Viscosity, S.U.S. @ 100° F.	35

Distillation, Bureau of Mines Routine Method

STAGE 1—Distillation at atmospheric pressure, 748 mm. Hg. first drop, 25° C. (77° F.)

Fraction No.	Cut at ° C.	Cut at ° F.	%	Sum, %	Sp. Gr., 60/60° F.	° API 60° F.	C.I.	Aniline point, ° C.	S.U. Visc., 100° F.	Cloud test, ° F.
1	50	122	6.0	6.0	0.632	92.4	...	46.8	...	...
2	75	167	4.3	10.3	.672	79.1	8.4	55.4	...	...
3	100	212	7.7	18.0	.719	65.3	21	52.2	...	...
4	125	257	8.7	26.7	.746	58.2	25	50.2	...	...
5	150	302	5.6	32.3	.767	53.0	27	49.8	...	...
6	175	347	5.2	37.5	.785	48.8	29	50.8	...	...
7	200	392	4.7	42.2	.800	45.4	30	53.6	...	...
8	225	437	4.7	46.9	.813	42.6	30	58.1	...	...
9	250	482	4.6	51.5	.827	39.6	31	62.4	...	...
10	275	527	5.5	57.0	.839	37.2	32	66.3	...	...
STAGE 2—Distillation continued at 40 mm. Hg										
11	200	392	3.2	60.2	0.849	35.2	33	72.0	40	15
12	225	437	5.1	65.3	.856	33.8	33	76.8	45	30
13	250	482	4.4	69.7	.870	31.1	36	...	57	50
14	275	527	4.3	74.0	.878	29.7	37	...	82	65
15	300	572	4.2	78.2	.887	28.9	36	...	145	90
Residuum			15.3	93.5	19.8	...	...	...	...	...

Carbon residue of residuum, 3.1%; carbon residue of crude, 0.9%.

Approximate Summary

	%	Sp. Gr.	° API	Viscosity
Light gasoline	18.0	0.679	76.9	.....
Total gasoline and naphtha	42.2	0.731	62.1	.....
Kerosine distillate	4.7	.813	42.6	.....
Gas oil	18.0	.842	36.6	.....
Nonviscous lubricating distillate	8.2	.862–.879	32.7–29.5	50–100
Medium lubricating distillate	5.1	.879–.884	29.5–28.8	100–200
Viscous lubricating distillate	...	....	....	<200
Residuum	15.3	.935	19.8	.....
Distillation loss	6.5	....	....	.....

although low, consists to an unusually large extent of volatile mercaptans and that the gasoline and other distilled products would be sour and might require more treatment than similar products from East Texas crude oil.

Utilization Possibilities

In discussing utilization possibilities, the same general system that was used in the first article of this series[1] will be followed, namely, a discussion of several of the important commercial products that might be considered for refining possibilities of a crude oil. It should be borne in mind that these are only indications and are based on rather limited data shown by the routine analyses. However, it is believed that they point out the possibilities with a fair degree of accuracy.

Aviation base stock: Inasmuch as the C.I. of Fraction 4 is less than the critical number 28, no base stock of value for aviation-fuel purposes could be prepared from this crude oil.

Motor gasoline: The comparison previously made with East Texas crude oils gives evidence that a good yield of gasoline of a reasonably good octane number should be obtainable from this crude oil. Calculations based on the routine analyses and on data in Technical Paper 722[2] would indicate a yield of approximately 50% gasoline having a 90% point of 392.

Actual distillation of two of the crude oils shown in Table 1, Items 3 and 4, provided the data regarding the gasoline that might be made from these crude oils as given below in Table 6. It would appear that sweetening would be all that might be required in the way of treating. Calculations based on Ryan's[6] data, as used by Guthrie and Simmons,[7] indicate that approximately three octane numbers can be gained by complete removal of the sulfur, assuming it is all mercaptans.

Kerosine: Although the analyses shown in Tables 2, 3 and 4 indicate in one instance 5% kerosine and in the other two about 10% kerosine, this division is entirely arbitrary and depends upon the API gravity of Fraction 9 being 40 or higher. Probably 10% of high-grade kerosine, with the possible exception of sulfur content, could be prepared from this crude oil. Trusty[8] shows that East Texas crude oil provides about 8% of 41° API kerosine, which is comparable with the kerosine that should be obtainable from the Scurry County area oil.

Diesel fuel: This crude oil should provide approximately 25% high-grade Diesel fuel having a cetane number of 50 or slightly over. This compares with a similar yield from East Texas having a similar cetane number. However, the Diesel fuel probably will be somewhat limited in its distillation range because the presence of wax causes a high pour point, although it is believed the pour point will be somewhat lower than a comparable distillation range for Diesel fuel from East Texas. If conditions permit, a Diesel fuel in the boiling range from 300 initial to a 675° F. 90% point would probably give a yield of somewhat over 40% with a good cetane number, but the pour point on this oil undoubtedly

TABLE 3—Routine Analysis of Strawn Limestone Crude Oil from No. Snyder Field, Scurry County, Texas

Identification

Sample 50028
Snyder, North field
Strawn limestone, Pennsylvanian
7322 ft.
Scurry County, Texas

General Characteristics

Sp. Gr.	0.826
API Gr.	39.8°
Sulfur, %	0.23
Pour point, ° F.	<5
Color	greenish black
Viscosity, S.U.S. @ 100° F.	38

Distillation, Bureau of Mines Method

STAGE 1—Distillation at atmospheric pressure, 736 mm. Hg. first drop, 27° C. (81° F.)

Fraction No.	Cut at ° C.	Cut at ° F.	%	Sum, %	Sp. Gr., 60/60° F.	° API 60° F.	C.I.	Aniline point, ° C.	S.U. Visc., 100° F.	Cloud test, ° F.
1	50	122	4.0	4.0	0.640	89.6	...	...	...	...
2	75	167	3.2	7.2	.672	79.1	8.8	55.8	...	...
3	100	212	6.1	13.3	.716	66.1	19	52.4	...	...
4	125	257	6.7	20.0	.742	59.2	23	50.1	...	...
5	150	302	6.1	26.1	.762	54.2	25	50.0	...	...
6	175	347	5.0	31.1	.780	49.9	26	51.5	...	...
7	200	392	5.6	36.7	.796	46.3	28	54.4	...	...
8	225	437	4.8	41.5	.808	43.6	28	59.2	...	...
9	250	482	5.4	46.9	.823	40.4	30	63.4	...	...
10	275	527	5.8	52.7	.837	37.6	32	66.9	...	...
STAGE 2—Distillation continued at 40 mm. Hg										
11	200	392	3.2	55.9	0.848	35.4	33	71.4	40	15
12	225	437	5.6	61.5	.858	33.4	34	75.0	44	30
13	250	482	5.7	67.2	.871	31.0	37	...	55	50
14	275	527	4.5	71.7	.881	29.1	38	...	76	70
15	300	572	5.6	77.3	.890	27.5	39	...	135	90
Residuum			20.9	98.2	.947	17.9	...	...	...	...

Carbon residue of residuum, 7.5%; carbon residue of crude, 1.8%.

Approximate Summary

	%	Sp. Gr.	° API	Viscosity
Light gasoline	13.3	0.683	75.7	.....
Total gasoline and naphtha	36.7	0.737	60.5	.....
Kerosine distillate	10.2	.816	41.9	.....
Gas oil	14.9	.848	35.4	.....
Nonviscous lubricating distillate	9.8	.865–.885	32.1–28.4	50–100
Medium lubricating distillate	5.7	.885–.895	28.4–26.6	100–200
Viscous lubricating distillate	...	....	....	>200
Residuum	20.9	.947	17.9	.....
Distillation loss	1.8	....	....	.....

TABLE 4—Routine Analysis of Ellenberger Crude Oil from the Dermott Field, Scurry County, Texas

Identification

Sample 50632
Dermott field
Ellenberger limestone, Ordovician
8,266-8,494 ft.
Scurry County, Texas

General Characteristics

Sp. Gr.	0.796
API Gr.	46.3°
Sulfur, %	0.17
Pour point, ° F.	<5
Color	brownish green
Viscosity, S.U.S. @ 100° F.	35

Distillation, Bureau of Mines Method

STAGE 1—Distillation at atmospheric pressure, 736 mm. Hg, first drop, 28° C. (82° F.)

Fraction No.	Cut at ° C.	Cut at ° F.	%	Sum. %	Sp. Gr., 60/60° F.	° API 60° F.	C.I.	Aniline point, ° C.	S.U. Visc., 100° F.	Cloud test, ° F.
1	50	122	8.5	8.3	0.630	93.1	...	48.2	...	...
2	75	167	5.4	13.9	.669	80.6	7.0	57.2	...	...
3	100	212	7.8	21.7	.713	67.0	18	55.1	...	...
4	125	257	7.7	29.4	.739	60.0	21	53.4	...	...
5	150	302	6.1	35.5	.762	54.2	25	52.2	...	...
6	175	347	6.0	41.5	.780	49.9	26	51.0	...	...
7	200	392	5.0	46.5	.799	45.6	29	52.8	...	...
8	225	437	4.7	51.2	.813	42.6	30	57.4	...	...
9	250	482	4.9	56.1	.825	40.0	31	61.6	...	...
10	275	527	5.6	61.7	.840	37.0	33	65.0	...	...
STAGE 2—Distillation continued at 40 mm. Hg										
11	200	392	3.5	65.2	0.852	34.6	35	70.8	41	15
12	225	437	4.8	70.0	.862	32.7	36	74.1	47	30
13	250	482	4.2	74.2	.875	30.2	38	...	60	50
14	275	527	3.9	78.1	.885	28.4	40	...	88	65
15	300	572	3.3	81.4	.895	26.6	42	...	165	85
Residuum			14.5	95.9	.945	18.2	...	...	...	...

Carbon residue of residuum, 7.6%; carbon residue of crude, 1.3%.

Summary

	Approximate %	Sp. Gr.	° API	Viscosity
Light gasoline	21.7	0.670	79.7	.....
Total gasoline and naphtha	46.5	0.721	64.8	.....
Kerosine distillate	9.6	.819	41.3	.....
Gas oil	12.6	.849	35.2	.....
Nonviscous lubricating distillate	8.0	.865–.886	32.1–28.2	50–100
Medium lubricating distillate	4.7	.886–.899	28.2–25.9	100–200
Viscous lubricating distillate	...	...	...	>200
Residuum	14.5	.945	18.2	.....
Distillation loss	4.1	.....	.....	.....

would be rather high for many uses.

Fuel oil: Inasmuch as this crude oil is a good source of Diesel fuel, it is obvious that it will provide excellent fuel oil, and fuel oil of most any grade desirable could be prepared depending upon the type of refining employed.

Jet engine fuel: Except for meeting the −76° F. freezing point specification, these Scurry County oils should provide a rather large yield of high-grade fuel for jet-propulsion engines. However, the wax content of the crude will probably cut down the yield of this fuel severely, so that a complete boiling-range jet fuel could not be obtained.

Lubricating oils: Comparison of the data on the lubricating distillate with comparable data for Burbank and Oklahoma City crude oils indicates that this crude oil should provide a 5 to 10% yield of medium viscous lubricating-oil stock. This should be susceptible to current refining methods and, of course, would require dewaxing. The carbon residue of the residuum is about the same as that of residuum from the Burbank, Okla., crude oil[1] and from the Wilcox or Arbuckle production from Oklahoma City.[4] The yield of residuum is about two-thirds of that from the other two oils just mentioned, and the gravity of the residuum is somewhat higher. Probably this would be better material to use for cracking stock than for production of the more viscous lubricating oils.

Asphalt: According to the method used in the previous article,[1] the asphalt content of this crude oil would be in the neighborhood of 5% of 100 penetration asphalt, which is relatively low, at least for West Texas oils. This compares to an estimated 10 or 11% of asphalt for East Texas crude oil.

All in all, these appear to be excellent crude oils for production of fuel, whether it be gasoline, Diesel fuel, or fuel oil, either "straight-run" or by cracking operations. Their major limitations in this regard seem to be the necessity for some sweetening to remove mercaptans, and dewaxing or undercutting to remove wax from certain types of fuels.

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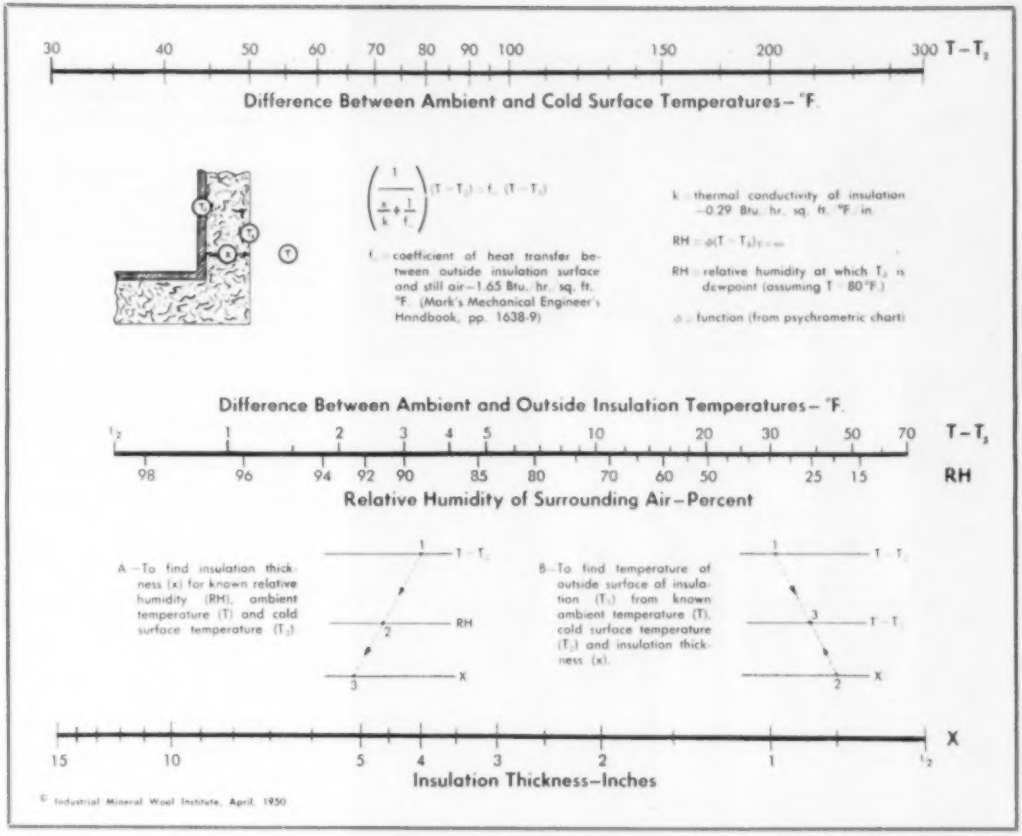
TABLE 5—Comparison of Permian Crude Oils and Recently Collected Scurry County Oils

Characteristic	Permian crude oils	Oils from Table 1
Gravity, ° API	24 to 33	38 to 46
Viscosity, seconds	42 to 98	35 to 40
Sulfur, %	0.60 to 2.76	0.10 to 0.40
Total gasoline and naphtha, %	21 to 30	33 to 46
Carbon residue of crude oil, %	2.7 to 8.3	0.7 to 2.1

TABLE 6—Data on Untreated Gasoline Distillate from Canyon Reef (Scurry County Area) Crude Oils

	Item 3*	Item 4*	East Texas[5]
Yield, Vol.—% crude	41.4**	48.9	35.0
Gravity, °API	57.0	60.0	60.0
D86 distillation, ° F.			
IBP	136	82	98
5% evaporated	155	...	...
10% evaporated	167	102	157
20% evaporated	186	153	182
30% evaporated	207	183	203
40% evaporated	228	213	228
50% evaporated	248	235	240
60% evaporated	274	260	270
70% evaporated	301	312	290
80% evaporated	327	326	323
90% evaporated	357	361	353
95% evaporated	376	381	382
E.P.	387	398	410
Loss, %	1.6	7.6	3.0
Sulfur, wt.—%	0.015	0.014	0.01
Octane number, motor method, clear	55.5	61.9	57.0
Octane number, motor method, 3 ml. TEL	77.0	81.6	...
Reid vapor pressure, lbs.	4.0	14.3	...

* See Table 1.
** Approximately 5.0% butane and lighter removed.


30 40 50 60 70 80 90 100 150 200 300 T – T_s
Difference Between Ambient and Cold Surface Temperatures – °F.
T
T_s
x
1
(1/(x/k + 1/f)) (T – T_s) = f_s (T – T_s)
f_s = coefficient of heat transfer between outside insulation surface and still air – 1.65 Btu. hr. sq. ft. °F. (Mark's Mechanical Engineer's Handbook, pp. 1638-9)
k = thermal conductivity of insulation – 0.29 Btu. hr. sq. ft. °F. in.
RH = φ(T – T_s)T = ∞
RH = relative humidity at which T_s is dewpoint (assuming T = 80°F.)
φ = function (from psychrometric chart)
Difference Between Ambient and Outside Insulation Temperatures – °F.
½ 1 2 3 4 5 10 20 30 50 70 T – T_s
98 96 94 92 90 85 80 70 60 50 25 15 RH
Relative Humidity of Surrounding Air – Percent
A – To find insulation thickness (x) for known relative humidity (RH), ambient temperature (T) and cold surface temperature (T_s).
1 T – T_s
2 RH
3 X
B – To find temperature of outside surface of insulation (T_s) from known ambient temperature (T), cold surface temperature (T_s) and insulation thickness (x).
1 T – T_s
3 T – T_s
2 X
15 10 5 4 3 2 1 ½ X
Insulation Thickness – Inches
© Industrial Mineral Wool Institute, April, 1950

INSULATION NEEDS for preventing sweating of cold surfaces can be figured quickly with this new nomograph

Alignment Chart Helps Solve Sweating Problems

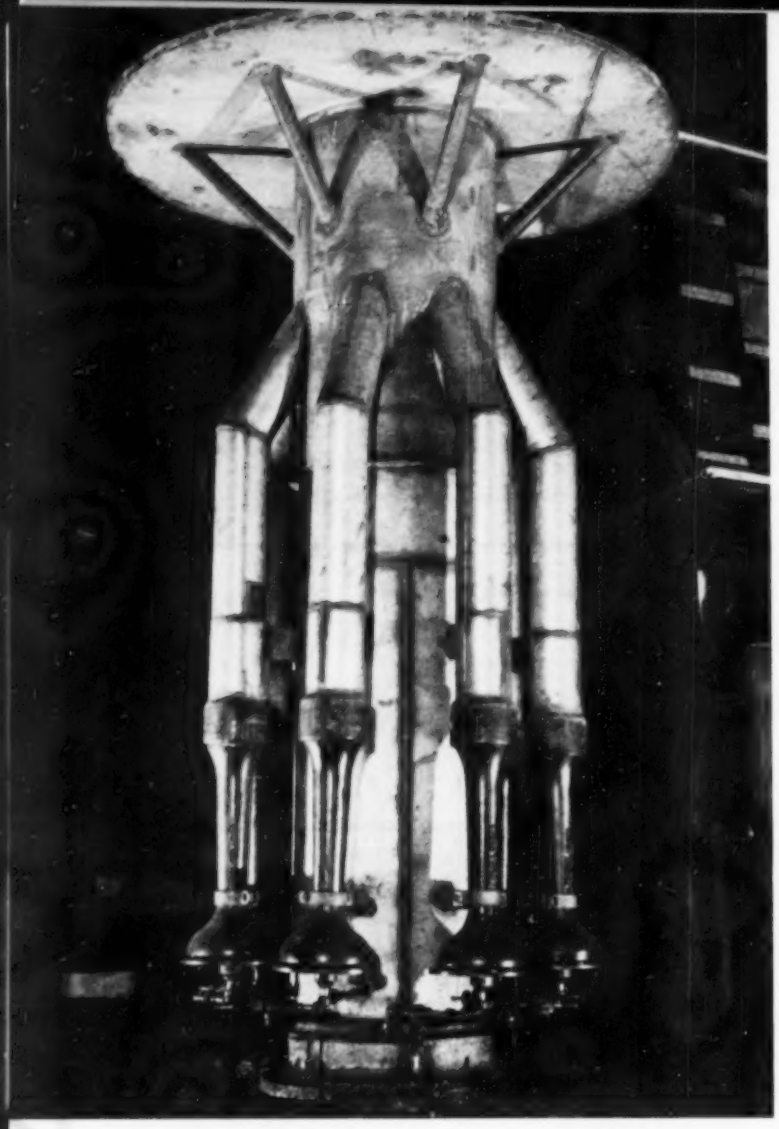
Gives Minimum Insulation Thickness Required To Prevent Condensation on Cold Surfaces

A NEW alignment chart has been developed by the Industrial Mineral Wool Institute for determining the minimum insulation thickness necessary to prevent cold-surface sweating. The new chart eliminates guesswork and the use of formulas, according to the Institute. It is applicable to piping, ducts, tanks and other refinery equipment and vessels containing cold air or other low-temperature fluids.

The temperature (T_s) of the cold liquid or gaseous material in the pipe or vessel, the relative humidity (RH) and the temperature (T) of the surrounding air (as shown in the diagram on the chart) are the conditions at each particular cold surface which determine the minimum insulation thickness which prevents sweating. Because it more than covers the practical ranges of temperature and humidity, the chart (based on K = 0.29, an average thermal conductivity for mineral wool insulation) is applicable to any cold surface.

Two examples illustrate how the alignment chart may be used. A sheetmetal duct in an air-conditioning system carries cool air at 48° F. through a basement where the ambient temperature often reaches 93° F. and the humidity rises as high as 85%. Then $T - T_s$ (93 − 48) is 45 and RH equals 85%. A straight line drawn through 45 on the left-hand scale ($T - T_s$) and 85 on the center scale (RH) is found to intersect the right-hand or x-scale at 1½ in.—the minimum insulation thickness required to prevent moisture from condensing on the cool-air duct.

In a second example, a tank containing liquid at 27° F. (T_s) is to be covered with 6-in. thick (x) blanket insulation (as recommended by Commercial Standard CS105-48, "Mineral Wool Insulation For Low Temperatures"). The maximum temperature of the surrounding air is known to be 82° F., but the plant superintendent must know the highest relative humidity that can be tolerated without sweating on the surface of the tank. Using the alignment chart, a straight line is drawn through 55 (82 − 27) on the left-hand ($T - T_s$) scale and 6 (x in inches) on the right-hand scale. The line crosses the center (RH) scale at about 94½%, the highest relative humidity that will not result in sweating. The center scale also indicates that, in this case, the temperature difference ($T - T_s$) between the surrounding air and the outside surface of the insulation is about 1½° F.



LOW OPERATING COST is key feature for this complex flare tip, shown on the shop floor shortly after it was fabricated

Flare Tip Gives Long Service Life at Low Operating Cost

All Requirements Were Met for Successful Disposal Of Waste Gas at Sohio's Cleveland Refinery with a Stack Design that Provides Long Service Life, Good Smoke Abatement, Safe Ignition, and Proper Burning

By W. S. SCHELLENTRAGER and H. G. BRIGGS,*
Standard Oil Co. (Ohio)

A GRADUAL development program over the past six years has resulted in a waste gas flare stack tip design which satisfies all requirements as to smoke abatement, proper ignition and combustion, and long service life at a low operating cost.

Normal operations of a refinery are accompanied by the production of unavoidable quantities of combustible gases which must be released to the atmosphere in times of emergency. In order to provide a safe and adequate means of handling this intermittent surge of gas at the Cleveland No. 1 refinery of Standard Oil Co. (Ohio), a new flare stack was built in 1944.

This stack consisted of a straight vertical unobstructed section of 24-in. O.D., steel pipe, 220 ft. high, the top 5 ft. of which was clad with an additional $\frac{3}{8}$-in. thick steel plate. The flare was also provided with a pilot light consisting of a high pressure gas line having an open end and an ignition system. The bottom of the flare stack was sealed against flashback by an 18-in. water seal inside a flashback seal drum.

During the operation of this stack, several undesirable features were encountered. The most obvious and objectionable was that poor combustion conditions existed at the tip. With the quantities of gas being released, the flare burned with a very black, smoky flame. This condition was undesirable particularly in view of the program of smoke abatement then being conducted by the city of Cleveland and Sohio. Secondly, wind currents at the top of the flare stack adversely affected the operation. The pilot light was blown out frequently. Also, down drafts caused the flames to roll down the outside of the flare tip. The extremely high temperatures existing at the points of flame contact over a period of time badly warped the top of the flare stack tip, and later produced long splits in the metal. Several pieces of hot metal dropped from the tip, endangering personnel in a large area below.

The high flame temperatures also produced cracking of the fuel gas in the pilot gas line, which in turn caused the top of that line to coke solidly, rendering it inoperable. Consequently it was necessary to bleed gas continuously into the flare system to insure ignition.

The straight pipe flare stack was definitely unsatisfactory and means for improving the combustion conditions were investigated. A flare tip having an external hood, as shown in

* W. S. Schellentrager is chief process engineer and H. G. Briggs is light ends division foreman at the No. 1 Refinery, Cleveland, of Standard Oil Co. (Ohio).

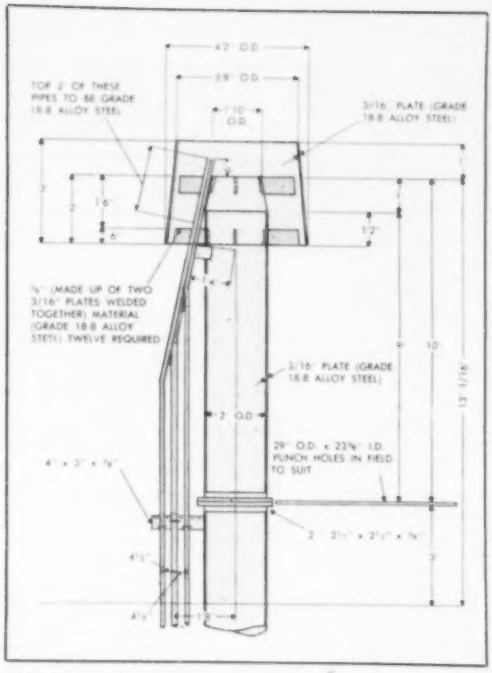

42" O.D.
38" O.D.
TOP 2' OF THESE PIPES TO BE GRADE 18-8 ALLOY STEEL
3/16" PLATE (GRADE 18-8 ALLOY STEEL)
3/16" PLATE (GRADE 18-8 ALLOY STEEL)
2" O.D.
29" O.D. x 23⅝" I.D. PUNCH HOLES IN FIELD TO SUIT

FIG. 1—First flare tip installed by Sohio was this simple design with an external hood

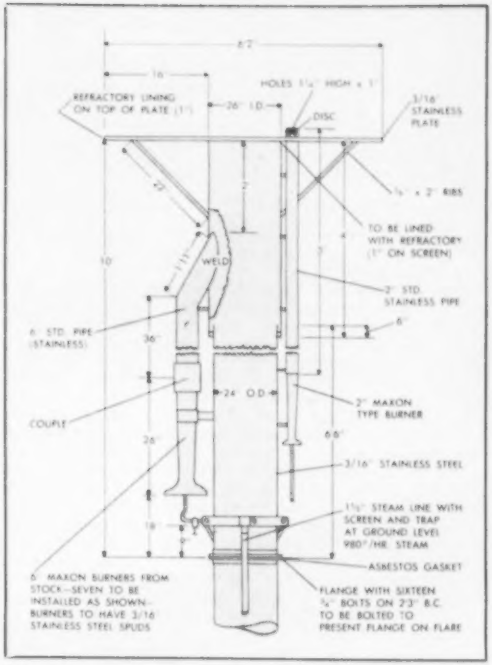

REFRACTORY LINING ON TOP OF PLATE (1")
HOLES 1¼" HIGH x 1"
DISC
3/16" STAINLESS PLATE
TO BE LINED WITH REFRACTORY (1" ON SCREEN)
WELD
2" STD. STAINLESS PIPE
6" STD. PIPE (STAINLESS)
COUPLE
24" O.D.
2" MAXON TYPE BURNER
3/16" STAINLESS STEEL
1½" STEAM LINE WITH SCREEN AND TRAP AT GROUND LEVEL 980#/HR. STEAM
ASBESTOS GASKET
6 MAXON BURNERS FROM STOCK—SEVEN TO BE INSTALLED AS SHOWN. BURNERS TO HAVE 3/16 STAINLESS STEEL SPUDS
FLANGE WITH SIXTEEN ¾" BOLTS ON 23" B.C. TO BE BOLTED TO PRESENT FLANGE ON FLARE

FIG. 2—General arrangement and design of flare tip as finally developed for use at Sohio's Cleveland plant

Fig. 1, was designed and installed by a large contractor working in the refinery at the time. The entire tip was fabricated from 18-8 stainless steel and was installed in October, 1945.

This design did not prove to have any appreciable operating advantage over the straight pipe. Flare gases being released at substantially atmospheric pressure did not have enough energy to inspirate any air through the hood mechanism to promote mixing as was contemplated in the design. After a relatively short period of operation, the supports for the hood failed due to the intense heat; and the hood collapsed, falling across the open end of the stack, making it unsafe to operate for any extended period of time.

At this point, the job was taken over by refinery personnel in an effort to devise a satisfactory flare tip that would overcome the objections already encountered. It was apparent that air had to be mixed with the gas stream prior to ignition without imposing any back pressure or creating any explosion hazard in the flare gas system. This problem was solved through the invention of a tip, the basic features of which are described below. This tip has recently been patented: U. S. No. 2,506,972, issued May 9, 1950, to the authors and E. S. Bale, assignors to Standard Oil Co. (Ohio).

The problem of mixing air with the flare gas was solved through using conduits which introduced air into the stack a short distance below the top. These conduits were placed at an acute angle to the main stack so that air was introduced in an upward direction. Thus the injection of air did not impose any back pressure on the system.

In order to put this idea into practical operation, it was necessary to determine the gas flow and air requirements. The main flare system piping did not have any connections which would accommodate a pitot tube or any similar measuring device. Since the flare system could not be shut down without also shutting down the catalytic cracking units, it was necessary to determine the average flare gas flow by observation of flame height. Gas flow was correlated with flame height by admitting measured amounts of gas into the flare system when no other emergency condition existed.

By this method it was determined that the average flow was in the range of 20,000 CFH. and its composition was roughly equivalent to propane. For complete combustion, approximately 400,000 CFH. of air would be required. It was felt that of 50% of this air requirement could be injected into the stack through air conduits as primary air and thereby mixed with the flare gas, the remaining air requirement could be taken from the atmosphere and substantially smokeless combustion would result. This presented a problem of supplying about 200,000 CFH. of air to the conduits which would be 200 ft. above ground elevation. Low pressure air blowers would not be prac-

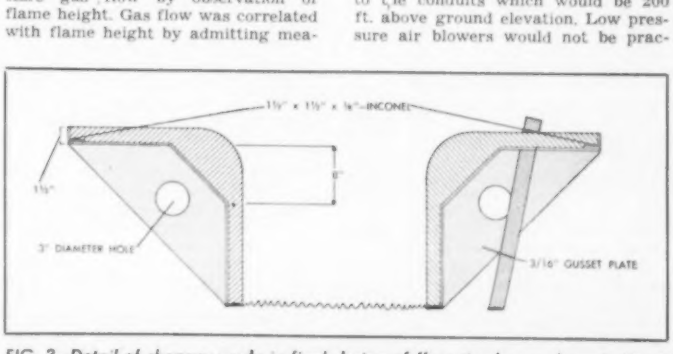


FIG. 3—Detail of changes made in final design of flare tip shown above in Fig. 2

TABLE 1—Cost Comparison of Various Tip Designs

Design	Months of Service	Construction Cost	Maintenance & Repair Cost	Total Cost	Cost per Operation
Straight	16	...	...	...	...
Hooded	12	$4450	...	$4450	$705
1st Tip	8	4500	705	5205	650
2nd Tip	29	4071	611	4682	161
3rd Tip	In service	6760	...	...	...

tical in this service, both from the air duct requirements and the operating cost standpoint.

The solution was found in the use of inspirating type gas burners (Maxon burners in this case) which are rather common equipment in refineries. Seven 6-in. Maxon burners were to be connected to the conduits a short distance below the point where the conduits would enter the flare stack. Steam supplied at 50 psig. to the Maxon burner jets would then inspirate the needed 200,000 CFH. of air for primary mixing. By sizing the burner jets so that 10 cu. ft. of air would be inspirated per one cu. ft. of steam, the steam requirement would be approximately 1000 lbs./hr. Steam was proposed for use in this installation rather than air because of its lower cost as compared to high pressure air.

"Wind-proof" Igniter

It was then necessary to provide a positive source of ignition for the flare gas-air mixture as it emerged from the tip. This problem was solved by a "windproof" pilot light which again employed an inspirating type gas burner. The high pressure gas would be fed to a 1½-in. Maxon burner in the normal manner, and the combustible gas-air mixture would then be conducted to the top of the stack through a 1½-in. alloy tube. It was felt this would overcome the coking problem of the original pilot installation and provide a stable flame. The top of the alloy tube would be covered and openings were to be provided around the side to direct the pilot flame and to prevent rain, dust, or back drafts from adversely affecting the operation. As in the case of the main air conduits, the 1½-in. Maxon burner would be located a short distance below the stack top to minimize piping requirements.

Experience with the straight pipe flare stack and the hooded design had indicated that protection was needed for the tip and stack proper to prevent rapid deterioration of equipment when subjected to extreme heat. An annular ring was therefore added to the top of the flare stack tip. This ring would prevent back drafts from forcing the flame down along the side of the stack. In normal operation, combustion of flare gases should be complete within the area encompassed by the annular ring. To protect the ring and the top of the stack from heat, the ring and the internal section of the stack tip were to be lined with refractory cement.

The general arrangement and design of this tip is shown in Fig. 2. The tip including air mixing equipment, windproof pilot light, annular ring and ignitor, was designed as a single compact unit so as to facilitate replacement and minimize downtime. Practically all the metal used in construction of the tip was high alloy. The first tip based on this design was fabricated almost entirely of 18-8 stainless steel. It was installed in October, 1946.

Initial operation was very satisfactory from the standpoint of smoke elimination and maintenance of ignition. The installation proved adequate to handle all but the abnormal gas flows. However, at this time a new complaint was brought to our attention—involving combustion resonance in the system. The explosion waves generated were of sufficient magnitude to cause undue vibrations in residences within a ½-mile radius of the flare stack.

Other unsatisfactory features of the original design became apparent after several months' operation. Spalling of the refractory lining of the flare stack and annular ring became noticeable and presented a hazard similar to that of the falling metal encountered with the previous stacks. This loss of protection against heat resulted in failure of the welds where the air conduits and the ring were joined to the main section of the tip. After approximately six months of service, the tip reached a mechanical condition which made it unsafe for further use.

Inconel Is Used

As soon as these new limitations in design became evident, further study was started. The failure of the 18-8 alloy to resist the service conditions led to an extensive survey of materials of construction available for such service. Arrangements were made to discuss the problem with engineers at the Lewis Flight Propulsion Laboratories of the National Advisory Committee for Aeronautics in Cleveland. As a result of this meeting, it was decided to use Inconel for the main construction material on the second flare stack tip.

The combustion resonance noticed in the first tip was eliminated by reducing the overall height of the tip from 10 to 7½ ft., thereby changing the vibrational frequency of the unit. In making this change, the entire reduction in overall height was made below the point of air injection to the stack in order that the burning characteristics of the gas-air mixture would not be altered.

The second flare tip was installed in June, 1947, and its operation proved very satisfactory. This more compact, lighter weight unit reflected in lower construction costs and also simplified the installation operation.

This tip remained in service for approximately 29 months. During this period the only noticeable difficulties were: 1) the rigid construction of the steam manifold assembly resulted in leakage in the connections between the main steam header and the Maxon burner jets, which reduced the efficiency of air injection to the tip, 2) failure of the weld where the annular ring joined the main section of the stack, was again noted, and covered an arc of about 90° at the time the tip was replaced.

Final Design Changes

Prior to the removal of this tip, the refinery management agreed to construct an additional tip as a spare for replacement purposes. Since the Inconel gave superior service, it was decided to standardize on this material for the replacement tip. However, cognizance was taken of the difficulties mentioned above, and several slight mechanical changes were made in the new construction. Flexible stainless steel hoses were used to join the main steam header to the Maxon burner jets. The 90° welded joint between the annular ring and the main stack was eliminated by using a junction piece at 45° angle, as shown in Fig. 3. This change resulted in less stress at the welded joints and also made possible a thicker refractory lining at this critical location. The new flare tip was installed in November, 1949, and is presently in service.

In addition to the preceding analysis of the tip, an analysis of the cost of the changes and the maintenance and repair charges is interesting. Table 1 shows the breakdown of these costs and the total unit cost of each installation on a monthly basis. It indicates the marked improvement from a cost standpoint of the Inconel construction.

The high construction cost of the 3rd tip is due to the inclusion of the cost of new hoisting equipment.

Also, the information in Table 1 is not complete because there are no records of maintenance and repair costs available for the straight pipe stack or the hooded design stack. However, the addition of such costs would only tend to magnify the improvement shown for the new design.

The following companies have made contract arrangements with Sohio as licensed fabricators, builders, and distributors of the new flare tip design: Clark Goodmand Supply Co., Cleveland; Western Supply Co., Tulsa; and Fritz W. Glitsch & Sons, Inc., Dallas.

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In cooperation with major oil companies, through the Gasoline Products Company, Kellogg has continued to refine thermal cracking methods over the years — contributing to such other forms as delayed coking and further adapting the process to thermal reforming of naphthas. Still the most economical means of producing medium-octane fuels and of breaking down the heavy ends, thermal cracking is expected to play a major role in refining for years to come.

The data, experience and know-how acquired by Kellogg in this continuous, thirty-year association with the basic thermal refining process will prove valuable to any refiner contemplating thermal additions or modernizations.

COMMERCIAL OPERATING DATA IS THE MAJOR DEVELOPMENT WEAPON!

With such variables as cold oil velocity, flow direction, heat per square foot, pressure, temperature of flue gases and furnace efficiency to be coordinated with wide operating flexibility, the designing of cracking and reforming furnaces to maintain long runs at low operating costs — without loss of efficiency through coking — is no mean task. Increased understanding of basic theory and improved basic engineering have contributed much to thermal cracking efficiency. But the reams of data acquired from commercial operating plants provide the soundest base on which to design new units. With a vast amount of this information at hand, accumulated over a thirty-year period and covering the widest possible range of applications, Kellogg is in a unique position to assist refiners.

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Plant Practices

Practical Tips and Ideas for Improving Operations

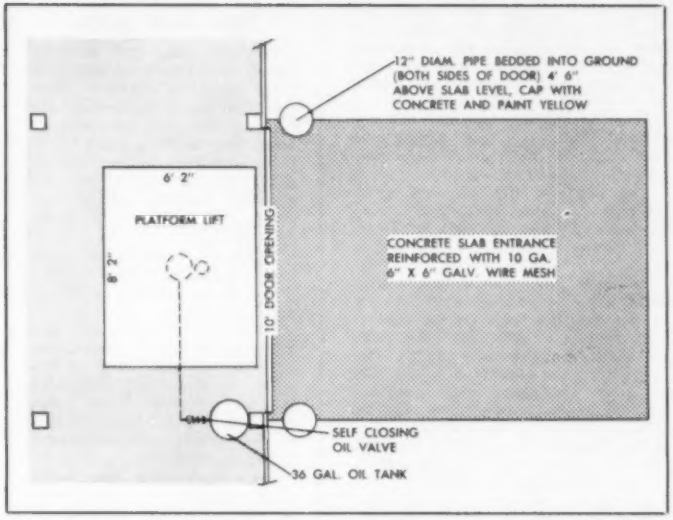
12" DIAM. PIPE BEDDED INTO GROUND (BOTH SIDES OF DOOR) 4' 6" ABOVE SLAB LEVEL, CAP WITH CONCRETE AND PAINT YELLOW
6' 2"
PLATFORM LIFT
8' 2"
10' DOOR OPENING
CONCRETE SLAB ENTRANCE REINFORCED WITH 10 GA. 6" X 6" GALV. WIRE MESH
SELF CLOSING OIL VALVE
36 GAL. OIL TANK

FIG. 1—General layout plan of the platform lift at the storehouse door of The Texas Co.'s Lockport refinery

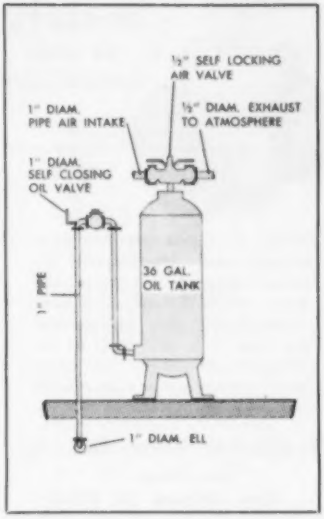
½" SELF LOCKING AIR VALVE
1" DIAM. PIPE AIR INTAKE
½" DIAM. EXHAUST TO ATMOSPHERE
1" DIAM. SELF CLOSING OIL VALVE
1" PIPE
36 GAL. OIL TANK
1" DIAM. ELL

FIG. 2—Detail of the oil reservoir for the hydraulic system

Hydraulic Lift Aids Material Handling At Large Texaco Refinery Storehouse

By G. D. MILTON
Assistant Storekeeper
The Texas Co., Lockport, Ill.

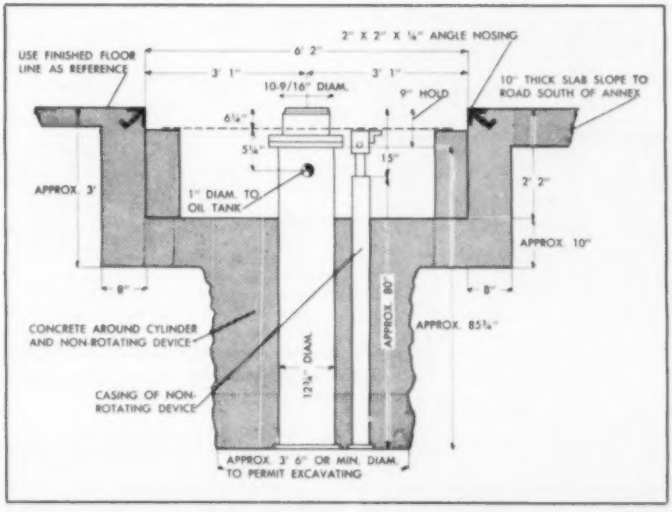

FIG. 3—Detail of the hydraulic lift arrangement

THE materials in the refinery storehouse at The Texas Co.'s Lockport Works are stored at ground level. Storehouse operations are encumbered by the lack of suitable means for handling material between the floor level and truck beds.

Because of this situation, it has been necessary, when loading or unloading heavy materials, to use a truck equipped with a winch, a truck equipped with a tail-gate loader, or to call out a small crane which is available in the plant. In some instances, heavy material has been unloaded by means of a chain hoist suspended from a high frame located outside the storehouse building. In such instances, no easy means of moving the material into the storehouse was available.

All these means of handling heavy material were unsatisfactory because all plant trucks are not equipped with winches, the small crane was not always readily available, and most materials received were unloaded from freight line trucks. As a result, delays in unloading and loading heavy

materials were experienced. To solve the problem, a platform lift was installed at the point where heavy materials are loaded and unloaded.

The platform lift installed has a 6 x 8 ft. steel platform supported by a hydraulic cylinder which is capable of moving the platform from the floor level to truck bed height. The platform has a lifting capacity of 6000 lbs. In order to get maximum use from the platform lift, materials that have a rapid turnover are stored as closely as possible to the lift.

It is anticipated this lift will result in considerable labor saving and will expedite material receipts and disbursements by trucks.

The platform lift installed is of the type furnished by several manufacturers. In this instance, a 36-gal. tank serves as an oil reservoir and is connected to the hydraulic cylinder by a one-inch line, with a self-closing valve which prevents back flow of the oil and thus holds the cylinder in any given position until the self-closing valve is manually opened. The oil reservoir is connected to the 100 psi. plant air system which provides the necessary pressure on the oil surface for lifting the platform. For lifting the platform, plant air is bled into the oil reservoir tank through a manually-operated throttle valve. For lowering the platform, the self-closing valve in the oil line to the cylinder is opened manually and an air locked valve on the reservoir tank is manually opened to the atmosphere.

The drawings in Figs. 1, 2, and 3 indicate the general layout of the installation, and details of the oil tank and the lift.

Flare Stack Series

Did you miss this month's article in PETROLEUM PROCESSING's series on refinery waste gas flare stack designs? It appears in this issue beginning on page 736, and presents complete details on a new flare tip developed by engineers with Standard Oil Co. (Ohio). Previous articles in this series have included:

"Reduced Hazards to Personnel Attained with Pure Oil's Flare Stack Igniter," June, p. 635.

"Gulf Oil's Flare Stacks Are Designed to Solve Three Important Problems," May, p. 511.

"No Open Flames or Sparks Produced by Safe Flare Stack Ignition Device," from Humble Oil & Refining Co., Baytown, Texas, April, p. 397.

Other companies have made items available for publication in future issues. Watch for them!

Pump Repair Man-Hours Are Sliced By Using Shop-Made Sleeve Remover

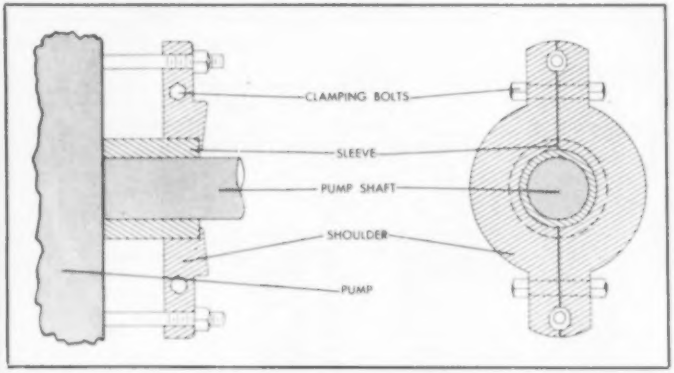

FIG. 4—Shop-built "sleeve" remover saves time and reduces damage to parts in pump repairs at Cities Service plant in East Chicago

A SIMPLE, shop-designed and made "sleeve" remover now in use at the East Chicago refinery of Cities Service Oil Co. has reduced pump repair man-hours and cut the loss of pump parts through damage during disassembly.

Consisting essentially of a split collar, the sleeve remover is shown in the sketch in Fig. 4. Having it

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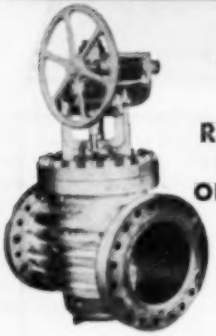

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BURNER COMPANY INC.

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split facilitates placing it around the shaft between the pump housing and the driver. In use, the nuts on the packing gland bolts are simply pulled down, the shoulder on the collar forcing the sleeve out to the left. The device also will serve to remove stuck or badly corroded impellers.

In one case involving maintenance on the centrifugals on a topping unit at the plant, the previous procedure of using a hammer and a cold chisel to drive the sleeve out always resulted in complete destruction of the sleeve and usually damage to the shaft and shaft bearings. Sleeve replacements averaged one per year per pump. The job of completely repairing the pump usually took 6 to 8 hours for one mechanic and a helper. With the new tool, the job can be done in 2 to 4 hours by the same two men. In many instances the sleeve can be machined for re-use.

The sleeve remover is applicable only on pumps having an overhanging impeller and is not beneficial on pumps which have a horizontal split case, whereby the rotating element can be removed and taken to the shop for repair.

Fluid Unit Slide Valves Maintained in Operation

SLIDE valves below the Fluid catalytic cracking unit reactor at the Baltimore Refinery of Esso Standard Oil Co. have presented the problem from time to time of sticking during normal operation. This condition leads to unit upsets because of improper slide valve operation.

To minimize trouble resulting from this condition, steam injection lines were installed above and below the seats of both valves to insure that packed catalyst would not bind the valve stem at the packing gland.

A mechanical aid also was worked out for turning the big hand wheels on the slide valves when severe plugging or binding conditions prohibited the satisfactory use of the hydraulic mechanism for control purposes. This device employed air motors supported securely in place on some angle iron brackets so that the motor drive shaft was directly in line with the end of the hand wheel shaft. A simple claw type clutch engaged the hand wheel spokes to transmit drive to the slide valve.

This arrangement saves considerable time and hard work since it was found that about 23 revolutions of the hand wheel spokes were required for a one-inch travel of the slide valve stem.

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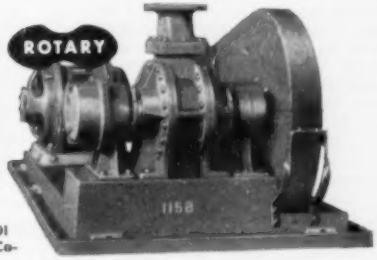
507 Texas Avenue, Connersville, Indiana

CENTRIFUGAL

Outdoor refinery installation of Type OI Centrifugal Blower. Capacity 11,750 cfm.

R-C Cycloidal Rotary Pump for handling gas or vapor together with liquids, in petroleum processing plant.



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[To obtain more data on advertised products see page 762]

Patent Trends in Petroleum Refining

By Peter J. Gaylor, Editor "The Technical Survey"

Solvent Simplifies Naphthalene Extraction from Cycle Oils

WORKERS at American Cyanamid Co. have discovered that iminodipropionitrile, which has the formula $HN(CH_2CH_2CN)_2$, possesses an extraordinarily high solvent action for condensed nuclei aromatics such as naphthalene and its homologs. The selectivity is so high that even with raw materials having high content of naphthalene, nonaromatic hydrocarbons are practically immiscible at room temperature.

A process has been developed and described in U. S. Patent 2,489,042, wherein naphthalenes from petroleum products containing them in proportions as low as 1% can be separated in relatively pure form. The selectivity of the solvent is not dependent on the presence of water as is the case with furfural. Also, according to the patent, a high overall efficiency, based on the solvent, is obtained and the negligible solubility of the solvent in non-aromatic hydrocarbons makes the recovery problem very simple.

Although the solubility of naphthalenes in iminodipropionitrile is not materially increased by high temperatures, even up to 200° C., the solubility of alicyclic compounds does become quite extensive at higher temperatures. This differential solubility of the alicyclics at various temperatures may be utilized to effect a 3-product separation. For example, the petroleum oil may be extracted with iminodipropionitrile at 100° C. or higher, the two layers separated and the extract cooled, say to room temperature. This will separate from the extract practically all of the alicyclic compounds which can be recovered by separation, the aromatics remaining in solution at room temperature being then recovered in the usual manner.

In one example, a light cycle gas oil from Texas crude having a 30% aromatic content, of which about 80% was naphthalene and homologs, was divided into three portions. One portion was subjected to a differential chromatographic adsorption by adsorbing a unit quantity in silica gel and progressively driving it out with methyl alcohol as a desorbing liquid. The refractive indices of the successive portions desorbed were measured and the results plotted in the usual chromatographic graph which is shown in dashed lines on Fig. 1. A dashed arrow indicates the refractive index of the starting material.

A second portion of the light cycle gas oil was treated with 1.25 volumes of wet furfural to produce an extract and raffinate. The furfural was then removed from the aromatic extract, the aromatics dried and subjected to the same chromatographic adsorption and desorption in silica gel. A chromatographic curve was obtained and is shown by the dotted line in Fig. 1. The refractive index of the aromatic extract before chromatographic treatment is shown by the dotted arrow.

A third sample of the gas oil was subjected to a single stage extraction with an equal volume of iminodipropionitrile and the aromatic extract after separation was washed with water to remove solvent, dried and also subjected to the same chromatographic adsorption and desorption, the curve being shown by full lines in Fig. 1, the refractive index of the whole extract being indicated by a full line arrow.

On the chromatographic curves, material having a refractive index below 1.5 is aliphatic and, for the most part, paraffins. Between 1.50 and 1.56 the products are predominantly alicyclic, and above 1.56 they are predominantly aromatic.

It will be noted that the aromatics constituted 30% of the original gas oil and the aliphatics about 45%. Furfural extraction produced a product in which the aliphatic content was reduced only to about 18-20%, the aromatic content being raised to about 50%, leaving almost 30% of contaminating alicyclics.

In the case of iminodipropionitrile extraction, an extract was obtained in which the non-aromatics were reduced to about 7%, and the aliphatics were not more than about 4%. In other words, almost all of the aliphatics, such as dodecane, were removed, thus eliminating any purification problem due to azeotrope formation.

Acid Treating Separates Paraffin Hydrocarbons

WHEN paraffin hydrocarbons are admixed with small amounts of aromatics, olefins and naphthenes, it is possible to separate the paraffins in a relatively pure state, according to a Shell Development Co. patent (U. S. 2,508,038), by treatment with a mixture of sulfuric acid and phosphoric acid. This mixture must be free of uncombined water and contain inorganic acid anhydride in excess of that required to convert all water present in the mixture into normal water-stable acid.

The preferred treating agent is a mixture of concentrated sulfuric acid and 5-30% by wt. of phosphorus pentoxide. Treatment is carried out at 10°-75° C. in a ratio of 2-20 volumes of acid per volume of hydrocarbon mixture. Tests were carried out with a synthetic mixture containing 86.4% n-octane, 3.6% dimethylcyclohexanes, 5.0% toluene and 5.0% of 2, 2, 4 trimethyl pentane.

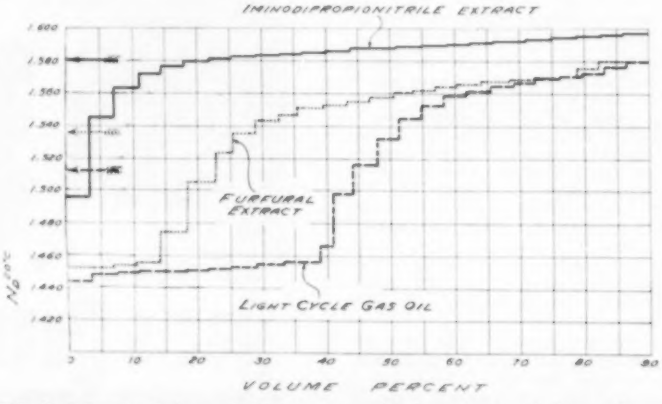


FIG. 1—Refractive indexes of three portions of light cycle gas oil from a Texas crude with 30% aromatics (U.S. 2,489,042)

Patents Issued in May

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for May 2, 9, 16, 23 and 30, Vol. 634, Nos. 1-5.

Fuels

2,506,089 (Sinclair Refining Co.)—Diesel fuel of increased cetane no. containing sulfurized polyolefin.
2,506,847 (Standard Oil Co.-Ind.)—Motor fuel stabilized with organo arsonic acid.
2,507,861 (The Texas Co.)—Diesel fuel oil from residual crude oil.

Conversions

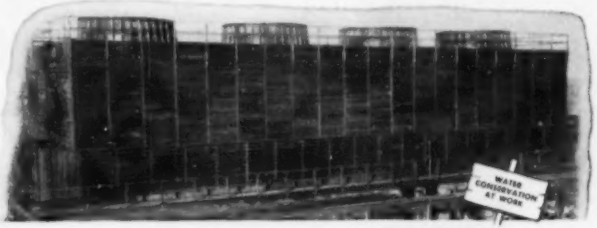
2,505,850 (Phillips Petroleum Co.)—Seal slot for catalyst bed screens in catalyst chambers.
2,505,851 (Phillips Petroleum Co.)—Catalyst vessel.
2,506,123 (Sinclair Refining Co.)—Pyrolytic conversion apparatus.
2,506,291 (Standard Oil Development Co.)—Catalytic cracking.
2,506,307 (Standard Oil Development Co.)—Contacting gaseous fluids and solid particles.
2,506,317 (Standard Oil Development Co.)—Removal of heat from finely-divided solids.
2,506,551 (Socony-Vacuum Oil Co.)—Alkylation of benzene.
2,506,720 (Phillips Petroleum Co.)—Vapor phase conversion with metal halide catalyst.
2,506,923 (Universal Oil Products Co.)—Conversion of hydrocarbons with silica-alumina catalyst.
2,507,220 (Sinclair Refining Co.)—Catalytic cracking using anhydrous ammonium fluoride catalyst.
2,507,523 (Houdry Process Corp.)—Conversion of heavy hydrocarbons containing asphalt.
2,507,538 (Miller)—Catalytic cracking of gases.
2,507,625 (Universal Oil Products Co.)—Ammonium phosphate impregnated conversion catalyst.
2,507,764 (Phillips Petroleum Co.)—Conversion of acid-soluble oils.
2,507,864 (The Texas Co.)—Polymerization of C_3 olefins.
2,508,014 (Shell Development Co.)—Catalytic reforming of gasoline.
2,508,744 (Standard Oil Development Co.)—Propylene polymerization.
2,509,019 (Socony-Vacuum Oil Co.)—Conversion of hydrocarbons with moving bed of solids.
2,509,028 (Socony-Vacuum Oil Co.)—Gasoline by alkylation and reforming.
Re. 23,237 (Lummus Co.)—Apparatus for catalytic conversion of hydrocarbon vapors.
2,509,745 (Sinclair Refining Co.)—Fluidized catalyst process for hydrocarbon conversion.
2,509,751 (Sinclair Refining Co.)—Fluid catalyst conversion with stripping and regeneration of fouled catalyst.
2,509,866 (Standard Oil Development Co.)—Low temperature combustion.
2,509,900 (Standard Oil Development Co.)—Supplying tempering steam and regeneration gas to catalyst.

Refining

2,505,824-5 (Petrolite Corp.)—Breaking petroleum emulsions.
2,505,871 (Phillips Petroleum Co.)—Continuously heating hydrocarbon oils.
2,506,289 (Standard Oil Development Co.)—Separating isomers with mercuric acetate.
2,507,560 & 910 (Petrolite Corp.)—Breaking petroleum emulsions.
2,508,038 (Shell Development Co.)—Refining hydrocarbons with sulfuric acid-P_2O_5.
2,508,723 (Phillips Petroleum Co.)—Separating hydrocarbons of close boiling points by multiple solvents.
2,508,817 (Tide Water Associated Oil Co.)—Sweetening light hydrocarbons with N-N'-dialkyl p-phenylene diamine.
2,508,867 (Shell Development Co.)—Separation of preferred fractions from apparently homogeneous gel particles.
2,509,044 (Standard Oil Development Co.)—Separation of low molecular weight hydrocarbons from hydrocarbon mixtures.
2,509,486 (Universal Oil Products Co.)—Silica gel separation of hydrocarbons.

Chemicals

2,505,792 (Shell Development Co.)—Cyclohexane free from benzene.
2,505,816 (Gulf Research & Development Co.)—4,6-Di-tert-butyl-2-methylcyclohexanone.
2,505,817 (Gulf Research & Development Co.)—Hydrogenated polyalkylated phenols.
2,505,870 (Phillips Petroleum Co.)—Secondary and tertiary alkylthiol amines.
2,505,910 (Standard Oil Co.-Ind.)—Sulfonic acid by oxidation of mercaptans.
2,506,857 (Phillips Petroleum Co.)—Mass polymerization of butadiene.
2,507,100 (Standard Oil Development Co.)—Fusible copolymeric resin.
2,507,105 (Standard Oil Development Co.)—Friedel-Crafts catalyzed low temperature isoolefin polymerization.
2,507,133 (Standard Oil Development Co.)—Nitrite ester diluent polymerization.
2,507,338 (Atlantic Refining Co.)—Polymerization of alpha alkyl styrenes.
2,506,471 (Sun Oil Co.)—Thiocyanated ether of 4-vinylcyclohexane.
2,507,472 (Sun Oil Co.)—Thiocyanoacetate derivative of 4-vinyl cyclohexene.
2,507,499 (Phillips Petroleum Co.)—Recovery of boron fluoride.
2,507,502 (Standard Oil Development Co.)—Oxygen carrier for oxidation of gaseous hydrocarbons.
2,507,645 (Gulf Oil Corp.)—Electrical determination of sulfuric acid concentration.
2,507,649 (Universal Oil Products Co.)—Treating wood tar distillates.
2,507,731 (Standard Oil Co.-Ind.)—Reacting phosphorus sulfide with olefins.
2,507,755 (Phillips Petroleum Co.)—Alkyl anilines.
2,507,765-6 (Phillips Petroleum Co.)—Alkyl benzenes.
2,508,005 (Shell Development Co.)—Cyclic thioethers.



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[*To obtain more data on advertised products see page 762*]

2,508,724 (Phillips Petroleum Co.)—Emulsion polymerization with diazo compound.
2,508,911 (Shell Development Co.)—Separation of neutral phthalic acid esters.
2,508,922 (Shell Development Co.)—Separating isoprene and cyclopentadiene.
2,508,993 (Socony-Vacuum Oil Co.)—Conducting gaseous reactions in presence of moving particle form solid.
2,509,136 (Gulf Oil Corp.)—Removing volatile organic compounds from dilute solutions.
2,509,205 (Standard Oil Development Co.)—Polymerized alkyl fumarates.
2,509,483 (Phillips Petroleum Co.)—Thiolesters.
2,509,855 (Standard Oil Development Co.)—Converting durene to carboxylic acids.
2,509,943 (Standard Oil Development Co.)—Divalent metal sulfonates.
2,509,873 (Standard Oil Development Co.)—Dicarboxylic acid anhydride.
2,509,874 (Standard Oil Development Co.)—Cyclic acetals.
2,509,877 (Standard Oil Development Co.)—Acetic anhydride.
2,509,878 (Standard Oil Development Co.)—Aldehydes.
2,509,885 (Standard Oil Development Co.)—Isobutylene purification.
2,509,891 (Standard Oil Development Co.)—Stabilizing xylidene.
2,509,938 (The Texas Co.)—Fused cyclic derivative of thiophene.

Lubricants

2,508,049 (Battelle Memorial Institute)—Lubricant containing selenophosphates.
2,508,510 (Standard Oil Development Co.)—Lubricating oil containing thiophosphoric organic salt.
2,508,570 (Socony-Vacuum Oil Co.)—Phosphosulfided lubricant.
2,508,572-3 (Standard Oil Co.-Ohio)—Lubricant containing amine-P_2S_5 product.
2,508,909-2 (Gulf Oil Corp.)—Lube oil additives comprising S-P treated octyl phenol.
2,508,905-6 (Gulf Oil Corp.)—Grease containing phenol-aldehyde condensation product as antioxidant.
2,507,055 (Gulf Oil Corp.)—Corrosion-inhibited oils.
2,507,103 (Standard Oil Development Co.)—Lubricating oil from naphtha containing olefins and oxygenated compounds.
2,508,617 (Cities Service Oil Co.)—Colored lubricating oil (greenish fluorescence).
2,508,741 (The Texas Co.)—Lubricating grease containing polyorganosiloxane.
2,509,316 (Atlantic Refining Co.)—Determining plugging of oil rings of internal-combustion engines using a radial light beam.
2,510,031 (Socony-Vacuum Oil Co.)—Inhibiting evolution of H_2S from sulfurized oil lubricants by metal soap.

Hydrocarbon Synthesis

2,505,752 (M. W. Kellogg Co.)—Separating organic compounds from hydrocarbon synthesis.
2,506,065 (Phillips Petroleum Co.)—Diolefins and motor fuels from carbon monoxide and hydrogen.
2,506,221 (Hydrocarbon Research, Inc.)—Catalytic synthesis of hydrocarbons.
2,506,226 (Hydrocarbon Research, Inc.)—Stainless steel catalyst for hydrocarbon synthesis.
2,508,743 (The Texas Co.)—High-pressure low-temperature catalytic conversion of CO.
2,509,204 (Standard Oil Development Co.)—Synthesis catalyst.
2,509,869 (Standard Oil Development Co.)—Hydrocarbon synthesis.

Specialties

2,506,059 (Gulf Research & Development Co.)—Increasing tensile strength of wax with aluminum stearate.
2,506,283 (California Research Corp.)—Air-blown polymerized asphalt.
2,506,903-4 (Gulf Oil Corp.)—Synthetic wax comprising higher fatty ester of fusible, soluble monoalkylated phenol-formaldehyde condensation product.
2,507,401 (Wagner Electric Corp.)—Brake fluid.
2,508,292 (Pure Oil Co.)—Vaporizing sulfur.
2,508,428-32 & 921 (California Research Corp.)—Compounding bitumen.
2,508,735 (Socony-Vacuum Oil Co.)—Ceramic glazing composition.
2,509,197 (Shell Development Co.)—Carbon remover and metal surface cleaning composition.
2,509,620 (Shell Development Co.)—Nonflammable hydraulic fluid.
2,509,764 (Shell Development Co.)—Insecticide.
2,509,777 (Shell Development Co.)—Asphalt-butadiene acrylonitrile copolymer composition.
2,509,786 (Shell Development Co.)—Corrosion preventive.

Catalysts

2,505,895 (Standard Oil Co.-Ind.)—Rounded gel catalyst particles.
2,506,122 (Sinclair Refining Co.)—Regeneration of fouled catalyst in stages.
2,506,316 (Standard Oil Development Co.)—Hydrogel beads by spray contact.
2,506,542 & 5 & 52 (Socony-Vacuum Oil Co.)—Regeneration of finely divided adsorbents.
2,507,496 (Houdry Process Corp.)—Molded catalytic contact masses.
2,507,603 (Phillips Petroleum Co.)—Rendering innocuous fluid flouride catalyst.
2,509,014 (Socony-Vacuum Oil Co.)—Heat-treating particle form solids.

Miscellaneous

2,506,293 (Standard Oil Development Co.)—Expansion joint.
2,506,352 (The Texas Co.)—Thermostat.
2,507,770 (Phillips Petroleum Co.)—Transducer for ultrasonic waves.
2,507,778 (Phillips Petroleum Co.)—Pressure vessel.
2,508,215 (Socony-Vacuum Oil Co.)—Removing protective coating films from surfaces.
2,508,881 (Richfield Oil Corp.)—Instrument for control of process variables (e.g. hot and cold water).
2,509,327 (Atlantic Refining Co.)—Micromanometer.
2,509,344 (The Texas Co.)—Thickness measurement using radioactive isotope.

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Free Fatty Acid (as oleic)	100 — 104%
Acid Number	199 — 206
Saponification Value	202 — 209

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[To obtain more data on advertised products see page 762]

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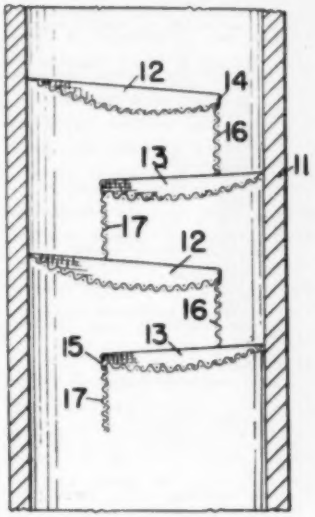

FIG. 1—One form of mesh packing designed for high efficiency in fractionating towers (U. S. 2,508,394)

FRACTIONATION TOWER PACKING of mesh or screen material has been designed in a form which distributes the reflux in thin films over wide areas in the path of the rising vapors in the column and which provides a longer path of travel for the vapors without necessitating an increase in overall height of the tower. The design is said to effect highly efficient fractionation, high throughput, and small H.E.T.P. (height equivalent to a theoretical plate) One form of the invention is shown in Fig. 1.

The tubular column 11 contains discs 12 and 13, fabricated of flat screen material. Each disc normally is flat and has a diameter greater than the inside diameter of the column. When the disc is disposed in the column, it is forced to assume a bowed position, and is held securely in place.

Discs have cut-out sections 14 and 15, respectively, extending from the edges toward the centers, and are so located that the cut-out sections lie on approximately opposite sides of the column. Vertical screens 16 and 17 in the form of tabs, are interposed between adjacent discs, over which the liquid flows from one disc to the next. Rising vapors pass through sections 14 and 15, which causes the vapors to travel back and forth across the column as they rise, and to contact the liquid film on the discs and the tabs.

U. S. 2,508,394, issued May 23, 1950, to Harry J. John, Philadelphia.

Organic Fibers Replace Steel In Pressure Vessel Wrapping

CERTAIN ORGANIC FIBERS can be utilized successfully as a substitute for steel wire wrapping in the construction of pressure vessels for storing and transporting liquefied petroleum gas, compressed fuel gas, uncondensible gas, and other materials which must be held under superatmospheric pressures at room temperatures.

Use is made of such long-chain molecular structures as Nylon, Rayon, or Saran, it is stated. The tensile strength of some of these fibers approaches that of steel wire, while their densities are about one-fifth that of steel. The adverse effect of the high thermal coefficient of expansion or contraction of these fibers—greater than that of steel or other metals—has been overcome by the design of the container or vessel itself.

This is accomplished by using a double-walled construction. The vessel consists of a center shell with a relatively low coefficient of expansion and an outer shell capable of expansion commensurate with the expansion of a liquid in the annular space between the two shells. The expansion of this outer shell under the influence of the expansion of the liquid is also commensurate with the relatively high coefficient of expansion of the organic fibers wound around the outer shell.

U. S. 2,507,778, issued May 16, 1950, to Frederick E. Frey, assignor to Phillips Petroleum Co., Bartlesville, Okla.

Catalyst Bed Supports Allow For Expansion without Leaks

CATALYST BED SCREENS can be supported by a seal slot in the catalyst chamber side wall insulation so that a tight seal against leakage is provided yet there is allowance for the free expansion of the screen with changes in temperature. The method of construction is illustrated in detail in Fig. 2.

The chamber wall 11 is covered with a layer of refractory material 12. A base plate 13 rests firmly in a horizontal position on the refractory and is held rigidly in place by anchor pin 19. An upper plate 14, spaced at the proper distance above plate 13 by bar 15, is similarly secured in the refractory material by retainer pin 18. The edge of the catalyst bed screen 20 rests between these two plates.

Plates 13 and 14 do not consist of simple annular ring members completely encircling the inner wall of the chamber, but instead comprise a series of individual plates arranged to form a circle around the walls. They are placed so that the ends of the upper plates overlap the ends of the lower plates. This arrangement, it is said, is preferable to the use of a single annular ring because each individual plate member expands only a relatively small amount as compared to the expansion of a solid ring for any given temperature increase. It also facilitates installation of the support.

U. S. 2,505,850, issued May 2, 1950, to Preston P. Briggs, assignor to Phillips Petroleum Co., Bartlesville, Okla.

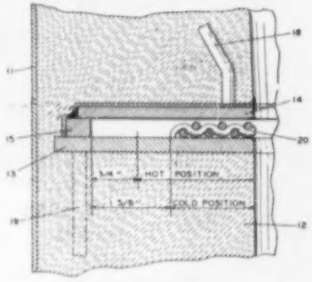

FIG. 2—Construction method for supporting catalyst bed screens to allow expansion and no leaks (U.S. 2,505,850)

Patents Issued in May

The following classified listing covers patents issued during the month of May believed to be of interest or value to petroleum processing and handling operations:

Catalytic Reactors

2,505,850 (Phillips Petroleum Co.)—Seal slot for catalyst bed screens in catalyst chambers.

2,505,851 (Phillips Petroleum Co.)—Catalyst vessel.

2,506,123 (Sinclair Refining Co.)—Apparatus for pyrolitic conversion of hydrocarbons.

2,507,538 (Ernest B. Miller)—Apparatus and method for catalytic treatment of gases.

2,509,041 (Socony-Vacuum Oil Co., Inc.)—Apparatus and method for heat-treating particle form solids.

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NORTH WALES, PENNSYLVANIA

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Equipment Patent Review

2,509,019 (Socony-Vacuum Oil Co., Inc.)—Apparatus and method for conversion of hydrocarbons with moving bed of solids.

Processing, general

2,506,542 (Socony-Vacuum Oil Co., Inc.)—Apparatus and method for regeneration of finely divided adsorbents.
2,507,325 (Petro-Chem Process Co., Inc.)—Bubble tower construction and method of fractionating vapors.
2,507,490 (Samuel J. Cohen)—Centrifugal apparatus and method for effecting chemical reactions, such as chlorination of organic liquids.
2,507,608 (Ernest B. Miller)—Apparatus for dehydrating gas and recovering condensable hydrocarbons therefrom.
2,507,662 (Danciger Oil & Refining Co.)—Heating apparatus.
2,507,823 (Phillips Petroleum Co.)—Pebble heater design.
2,508,041 (Gilbert & Barker Mfg. Co.)—Bubble cap assembly.
2,508,120 (Harold E. Lonngren)—Apparatus and method for thermal conversion of hydrocarbons.
2,508,394 (Harry J. John)—Fractionating column.
2,509,172 (Konrad F. Schreier and Ben Bartoluccl)—Fractionating column.
2,509,683 (Infilco, Inc.)—Liquid treating apparatus and process.
2,509,695 (Infilco, Inc.)—Clarifying apparatus and process.
2,509,866 (Std. Oil Development Co.)—Low-temperature combustion and apparatus therefor.

Instruments

2,505,905 (Universal Oil Products Co.)—Fluid flow meter.
2,506,080 (Gen'l. Aniline & Film Corp.)—Electron diffraction apparatus.
2,506,535 (Nina D. Zaikowsky)—Gas analysis apparatus of the thermal conductivity type.
2,508,434 (Phillips Petroleum Co.)—Liquid level control.
2,508,572 (Universal Oil Products Co.)—Gas analyzing apparatus of the thermal conductivity type.
2,508,881 (Richfield Oil Corp.)—Process control apparatus.
2,509,046 & 048 (Minneapolis-Honeywell Regulator Co.)—Temperature responsive measuring apparatus.
2,509,327 (Atlantic Refining Co.) — Micromanometer.
2,509,497 (Cardox Corp.)—Smoke detector.
2,509,770 (Prenco Progress & Engineering Corp. Ltd.)—Tank gauge for oil and other liquids.

Tools

2,506,066 (Kenneth W. Coates)—Worm nut brake for adjustable end wrenches.
2,507,124 (Shell Development Co.)—Tube testing device.
2,508,291 (Frank Porro)—Re-threading tool.
2,508,604 (John J. Greer and Samuel C. Greer)—Ratchet wrench.
2,508,997 (The Aro Equipment Corp.)—Impact wrench.
2,509,637 (Oswald M. Gross)—Sliding jaw end wrench.

Pumps

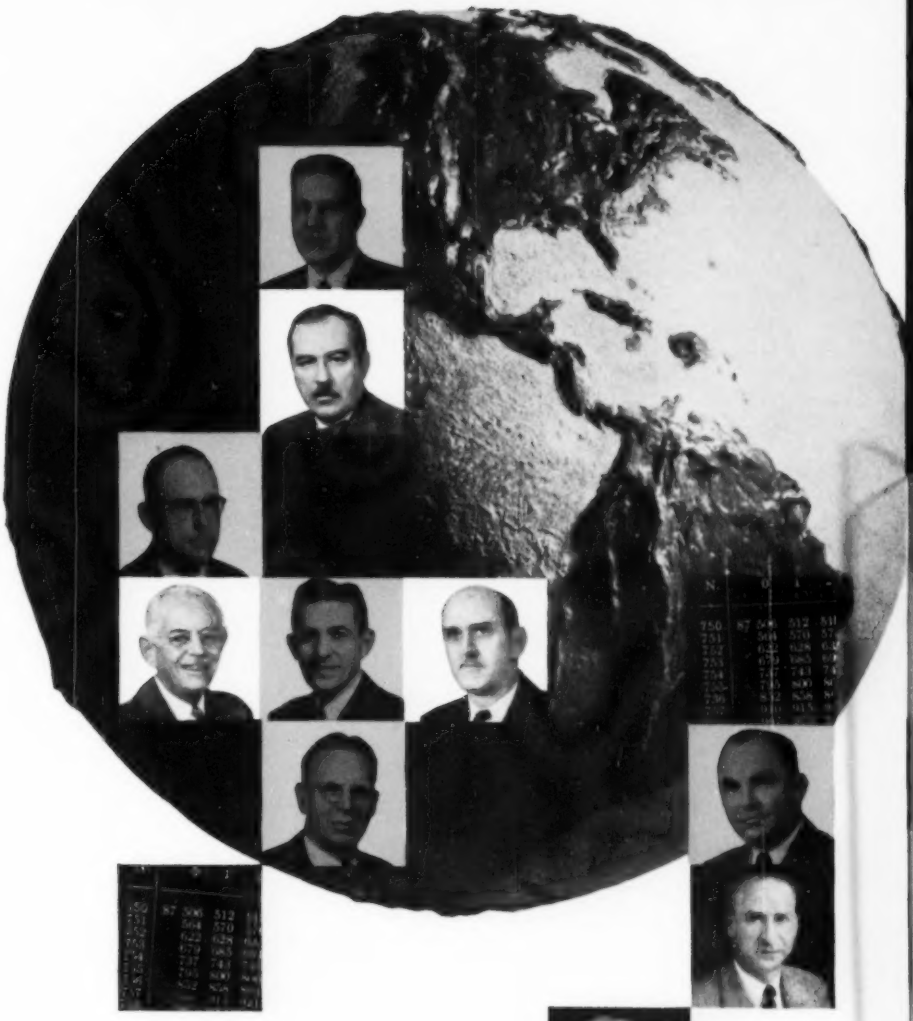
2,509,321 (Gulf Research & Development Co.)—Rotary fluid unit for take-off under variable control.
2,509,973 (Niles-Bement-Pond Co.)—Seal for fluid pumps.

Valves and Fittings

2,505,970 (The Duriron Co., Inc.)—Plug valve.
2,505,971 (The Duriron Co., Inc.)—Mechanical lift plug valve.
2,507,851 (Fluid Control Engrg. Co.)—Valve construction.

Miscellaneous

2,505,774 (Air Preheater Corp.)—Multifluid heat exchange passage construction.
2,506,293 (Std. Oil Development Co.)—Expansion joint.
2,506,972 (Std. Oil Co.—Ohio)—Flare stack tip.
2,506,996 (Research Corp.)—Protective device for electrical precipitators.
2,507,595 (Phillips Petroleum Co.)—Apparatus, including an air trap, for unloading liquid from tank cars.
2,507,604 (Phillips Petroleum Co.) — Cooling tower construction for improved water distribution over coils.
2,507,778 (Phillips Petroleum Co.)—Pressure vessel for liquified petroleum gases and similar fluids.



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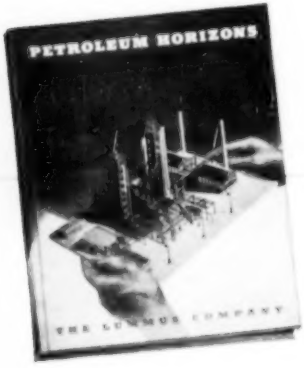

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Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

The Questions and Answers presented here were transcribed from a wire recording of the popular "Information Please" session of the 29th Annual Convention of the Natural Gasoline Assn. of America in Fort Worth, April 26, 1950. Publication is made possible through the cooperation of the various authorities participating, W. F. Lowe, NGAA Secretary, and J. H. Dunn, The Shamrock Oil & Gas Co., Session Moderator.

Temperature Required For Dryer Regeneration

Is a higher temperature required to regenerate solid type dryers at 1200 psi. than at 250 psi.? If so, what temperature is required?

Speaking qualitatively, I would say about the same temperature range is required at 1200, 250, or 50 psi., for that matter. In all the operating dehydrating units I've seen, the temperature at which the water comes off—that plateau that you get during regeneration—occurs around 200° F. At one plant where the drying operation is at about 900 psi., the plateau is at about 250° F.

This means the temperature of the gas being used in regeneration has to be hotter than, say, 200° F., or the plateau temperature, so there will be a source of heat to warm up the dehydration agent and steel in the vessel and also enough to drive off the water.

A temperature of about 350° F. is high enough to regenerate the common solid desiccants. That temperature provides a sufficient temperature differential to furnish the heat needed to the equipment and expel the water in a reasonable length of time. A higher temperature gas would permit regeneration in a shorter length of time and might be desirable if the tower is very large and contained a large weight of steel, insulation and desiccant that would cause a greater heat load. A higher gas temperature also may give benefits in driving off heavy ends from the adsorbent.—Will Swerdloff, Magnolia Petroleum Co., Dallas.

Use of Natural Gasoline In Motor Fuel Blends

The present competitive motor fuel octane levels are the highest ever known and the trends are to still higher levels. In your opinion, will this tend to adversely affect the volume of natural gasoline that will be blended in motor fuel? If so, what recourse have the natural gasoline manufacturers to alleviate such a situation?

That question has been discussed at this convention, but in view of the current price situation on natural gasoline vs. motor fuel, with natural going at about 4c for 26 lb. and motor fuel around 9.5c, I am very much surprised that more has not been said. After all, this is the drum we've been thumping in this association for quite a few years to promote the use of natural gasoline.

I tend to differ with some of the opinions that have been passed on the limitation of the use of natural gasoline in motor fuel. I do not think we are faced at the present time with an octane number limitation. I believe that in the future we will first be faced with a volatility limitation, but are not faced with it yet.

Currently the blending of natural gasoline is about to the extent of 10% of the total motor fuel produced. Of the 8 or 900,000,000 bbls. of motor fuel annually produced in this country, just about 100,000,000 bbls. are natural gasoline. We know from experience that natural can be blended to the extent of 25 or 30%, more than double the current volume being used. So we are talking about another 150,000,000 bbls. which can be soaked up.

One of the reasons for the differences in opinion on this is that people tend to fail to define what we are talking about. We should define the limitations on the use of natural in terms of "intensive" volatility and "extensive" volatility.

Most of the talk has been directed at "intensive" volatility, thinking of vapor pressure. Vapor pressure is just another name for 10% point or butane content. By reducing the "intensive" factor through eliminating a little of the butane from motor fuel, a great deal more of the pentanes and heavier fraction of 12-lb. gasoline can be incorporated. It affects the "extensive" volatility factor of the motor fuel, normally noted at about the 40 or 50% point of the distillation curve. But there is a great deal more room for natural in motor fuel that's not being soaked up now.

There is a chance for more even distribution of the natural through the annual motor fuel requirements to help the present situation and I believe this is strictly a matter of salesmanship. So much for the volatility angle.

The octane number level appears to be still increasing at about a continuation of the pre-war rate—there was an interruption during the war—but the increase is now something like three-fourths to one octane number a year. It appears to be continuing, promoted to some extent by the fact that there is a surplus of motor fuel producing capacity.

During the war a number of new refining processes were developed, many new plants were built and, for a period after the war up until a couple of years ago, those facilities were very well loaded in order to make volume. Now that there is an excess of motor fuel supply, those facilities are tending to turn more to the production of "quality."

But, inherent in some of these processes, is what might be called a "ceiling octane number." Probably 90, 91, or 92 is about that ceiling because thereafter destruction of the feedstock offsets any further advantage gained by an additional octane number increase. We probably will not reach those levels for several more years.

Natural gasoline, when we examine it, does not make a bad comparison with such motor fuel octane levels. Twenty-six pound gasoline has about a 75 octane clear and about 90 with 3 cc's of lead. By some of the processes mentioned earlier, such as catalytic reforming for natural, or conversion of the butane content of the 26 lb. gasoline, or conversion of all the light hydrocarbons in raw gasoline lighter than the pentanes and heavier, such quality can be improved.

Actually, you can convert 26 lb. natural gasoline into a very superior motor fuel, better than the competitive quality today and as good as we'll reach in several years. One could remove the butane fraction of 26 lb. gasoline, for instance, isomerize part of the butane and crack the remainder, followed by alkylation of the resulting olefins and isoparaffin.

Incorporation of that alkylate with

the 12-lb. gasoline would yield about a 7 or 8-lb. finished product—a satisfactory motor fuel having a good boiling range and testing about 71 or 72 octane clear; 85 octane leaded. Research and ASTM Motor octane numbers will be approximately the same. Therefore, when rated on a Research basis and compared with refinery products on the same basis, the material would be superior—that is, the Road octane rating would be better because the Motor and Research ratings are about the same.

The incorporation of total ethane, propane and butane through cracking and alkylation processes and combining this material with the 12-lb. gasoline, will permit one to achieve octane numbers of about 80 clear, or perhaps a little better than that, and above 90 with 3 cc TEL.

The economics of such processing schemes are very good. While this may not appeal to some people who have only a small amount of material, it should appeal to producers who have large volumes of natural gasoline, or to buyers who can have, in the aggregate, considerable quantities to work with.

It does not take the fingers of both hands to figure that, if you start with about 5000 b/d of 26-lb. natural gasoline as a plant product, you probably will have 10,000-12,000 b/d of total raw gasoline. Conversion of the butanes and lighter from this will yield about 3000 b/d of high quality alkylate product. When incorporated with the 12-lb. gasoline, this will yield about 6000 to 7000 bbls. of motor fuel.

Now, comparing the raw gasoline on the basis of its 26-lb. content at 5c per gal. and LPG at 2.5c per gal., as compared to getting 10c per gal. for that 6000 bbls. of motor fuel from that plant, gives about $10,000 or $12,000 a day difference in income. This amounts to around $4,000,000 annually. This will pay out a good bit of equipment in 10 years' time. I think this is the way we should look at that kind of a picture.—H. R. Legatski, Phillips Petroleum Co., Bartlesville.

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Market Trend—Refined Vs. Natural Gasoline

Has the general level of the natural gasoline market, in relation to the motor gasoline market, been progressively lower over the last two years?

With the growth of catalytic cracking, we have lost our stick in the natural gasoline end of the oil business to some extent, for the reason that we do not have the appeal to the refiner from the standpoint of an octane improvement to his motor fuel. He has sufficient light ends on hand and he is independent of us—moreso than he has ever been since I have been in the business and that's a long while. Then add to this the fact that since 1945 we have doubled the production of natural gasoline and cycling plant gasoline whereas you have only increased your production of refined gasoline from crude approximately 21%.

Now, as we develop this market we must recognize that we are, in my opinion, a bulk product. The refiner will use this product so long as he can make money. This may be overcome later but that is the situation existing today, plus the additional fact that, in the last two years, you have had a very small export market on account of the Sterling and gold situation. It may be that if this situation continues that the Natural Gasoline Assn. should look into the possibilities of making motor fuel directly from natural gasoline.

I do not think anyone knows what is going to happen in the next year or two because that all depends on whether or not we continue to in-

crease production of this product. It will find a home but it has to find a home at a price whereby the refiner can make money.—Mark S. Patton, Hurley Gasoline Sales Co., Tulsa.

Losses by Mixture in Product Pipe Lines

How do you handle several products through the same line and how much mixed products do you lose in the operation?

The basis of all modern pipelining, of course, is the "tight line" operation, wherein you pump directly from one station to the next. With products such as now are handled in pipe lines—and we are handling 30 to 32 different products—in most cases one product is put next to another which has a compatible specification. The amount of mixture which can be tolerated is determined in advance and also the amount of mixture occurring in the actual pipe line.

As a matter of fact, if an authoritative reference is desired, R. K. Schulze and I delivered a paper on this subject at the API in November, 1947. However, the mixtures which actually result in properly handled pipelines are so small as to be almost insignificant. For example, in a 250 mile, 8-in. diameter line, the mixtures between propane and butane range from 70 to 90 bbls. at the end of the run. On heavier products, such as distillates or gasolines, this will increase to perhaps 200 to 300 bbls.

Actually, this can be accurately and carefully calculated so that the amount of base products required to soak up the mixture can be determined in advance. In 12 years of pipelining we have yet to ship a barrel of product back to the refinery or redistill anything as a result of pipe line mixtures.—S. S. Smith, Shell Oil Co., New York.

MEETINGS
. . . for the Oil Man

JULY

10-14, Society of Chemical Industry, Sixty-Ninth Annual Meeting, Newcastle-on-the-Tyne, England.

AUGUST

14-16, Third Western Packaging Exposition, Civic Auditorium, San Francisco.

14-16, Society of Automotive Engineers, West Coast Meeting, Biltmore Hotel, Los Angeles.

SEPTEMBER

3-8, American Chemical Society, 118th National Meeting, Chicago.

5-9, American Chemical Society, 6th National Chemical Exposition, Chicago Coliseum, Chicago.

10-13, American Institute of Chemical Engineers, Regional Meeting, Radisson Hotel, Minneapolis.

13-15, National Petroleum Assn., Hotel Traymore, Atlantic City.

18-20, National Butane-Propane Assn., Congress Hotel, Chicago.

18-22, Instrument Society of America, Fifth National Instrument Conference and Exhibit, Memorial Auditorium, Buffalo.

19-21, American Society of Mechanical Engineers, Fall Meeting, Hotel Sheraton, Worcester, Mass.

25-27, American Society of Mechanical Engineers, Petroleum Division Conference, Roosevelt Hotel, New Orleans.

26-27, American Institute of Mining and Metallurgical Engineers, 1950 Mid-Year Meeting, Neil House and Deshler-Wallick Hotels, Columbus, Ohio.

26-29, Industrial Packaging and Materials Handling Exposition, Philadelphia.

27-30, Society of Automotive Engineers, Aeronautic and Aircraft Engineering Display, Biltmore Hotel, Los Angeles.

OCTOBER

2-6, American Gas Assn., Annual Convention, Atlantic City.

3-6, National Lubricating Grease Institute, Annual Meeting, Roosevelt Hotel, New Orleans.

16-20, National Safety Congress, National Safety Council Exposition, Chicago.

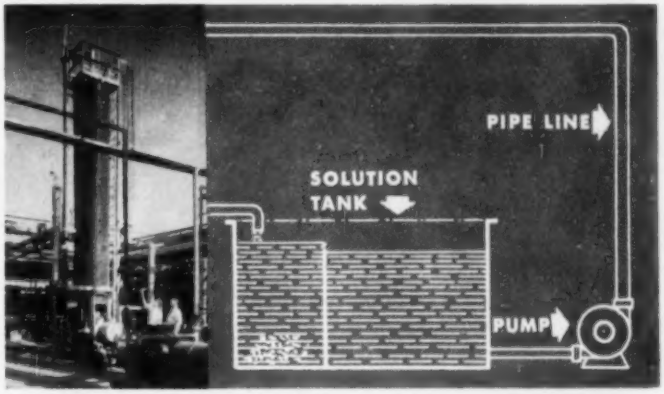
23-27, American Institute of Electrical Engineers, Fall General Meeting, Skirvin Hotel, Oklahoma City.

23-27, American Society for Metals, Annual Meeting, Chicago.

24-, Assn. of Consulting Chemists and Chemical Engineers, Inc., Annual Meeting, Shelburne Hotel, Skyline Room, New York.

27, Natural Gasoline Assn. of America, Southern Regional Meeting, Blackstone Hotel, Tyler, Texas.

30-Nov. 1, National Lubricating Grease Institute, Annual Meeting, Edgewater Beach Hotel, Chicago.



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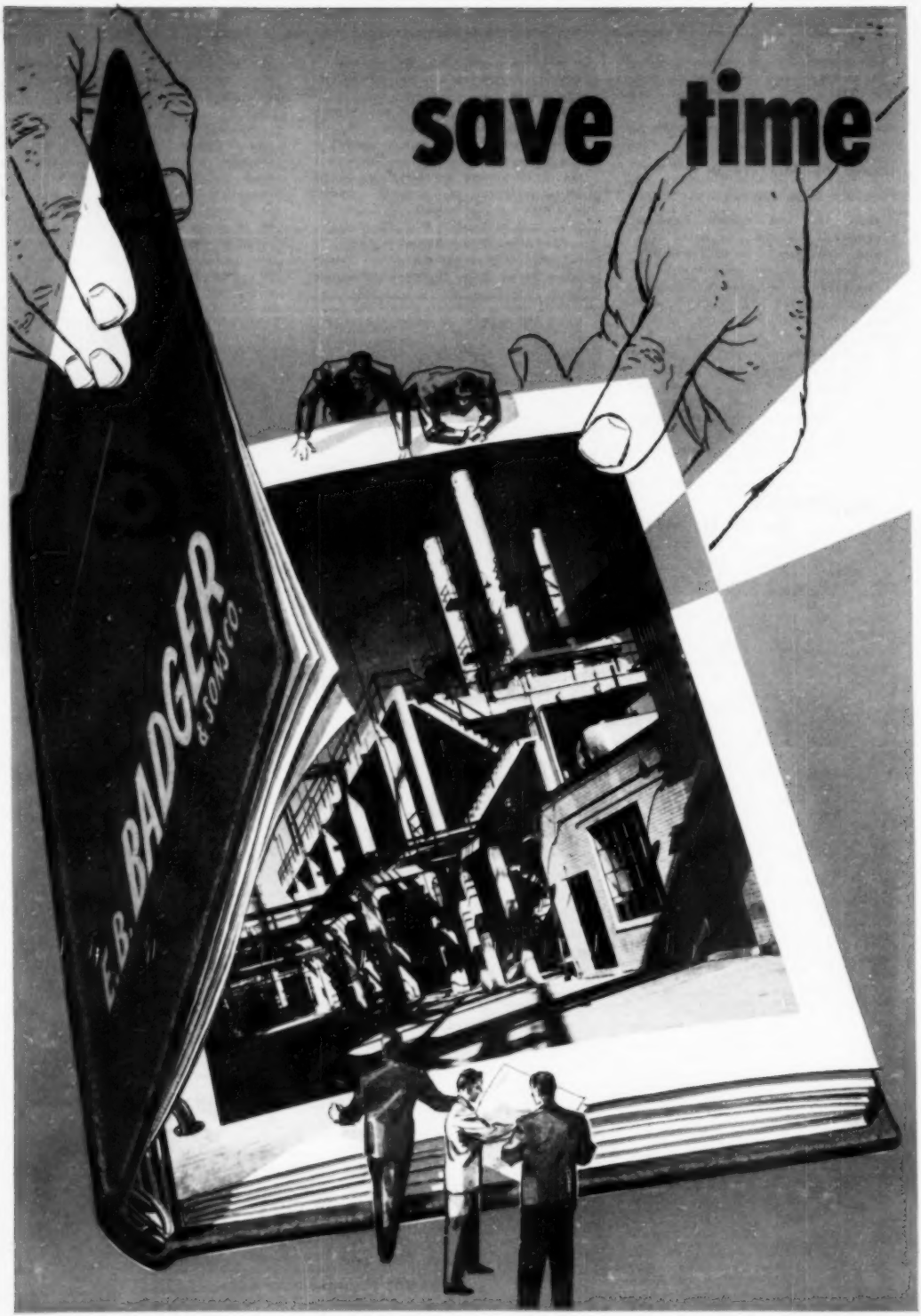
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Mine Safety Opens New Laboratory

What is described as the world's largest laboratory devoted to the development of safety equipment for all industries was dedicated June 14 in Pittsburgh by the Mine Safety Appliances Co. Many types of activities are being conducted in MSA's program in four-story building near the company's main factory. These include work on safety and first aid equipment for the petroleum industry as well as a number of instruments useful in refining, hydrogen sulfide indicators, carbon monoxide recorders, gas analyzers, etc.

Open House at American Cyanamid

The Stamford, Conn., research laboratories of American Cyanamid Co. were opened to the public in May for the first time since they were established in 1936. The facilities comprise a large, five-story building and a number of smaller structures on the Boston Post Road, just west of Stamford. When first occupied, there were 225,000 sq. ft. of floor space. Today, the original area has been expanded to more than 410,000 sq. ft.

Lebanon Licensed to Make New Alloy

Lebanon Steel Foundry has effected licensing agreements with Timken Roller Bearing Co. to produce and sell a patented, heat-resistant super-alloy known by the trade-mark "16-25-6", both patent and trade-mark registrations being owned by Timken.

Originally developed as a wrought material, the alloy has demonstrated high mechanical properties for exacting services such as are required for rotor wheels for turbo-superchargers, jet engine, and gas turbine applications. It has high creep resistance and rupture strength at temperatures up to 1200 to 1500° F.

Steel Container Plant for Port Arthur

United States Steel Products Co., a subsidiary of U. S. Steel Corp., will begin construction in the near future on a modern steel container plant in Port Arthur, Texas. It will replace facilities that were burned in 1945. The new structure will be located approximately at the mouth of the west turning basin in Port Arthur and a third of a mile north of the intra-coastal canal.

Specialty Tubing Now Made in Gary

Specialty steel tubing, both seamless and welded, ranging in sizes from ½ to 9 in. O.D., can now be produced at the revamped and modernized Gary Works (Indiana) of the National Tube Co., a United States Steel Corp. subsidiary. Most unusual of the new equipment is a push-button, seamless mill, which features continuous rolling on a mandrel and incorporates a stretch-reducing process. This latter process is especially suited for the manufacture of small diameter tubing in long lengths, it is stated. Delivery speeds run from 850 to 1700 ft./min.

Brown Starts Instrument Courses

Brown Instruments Division, Minneapolis-Honeywell Regulator Co., will open its second half of 1950 maintenance and repair courses at the company school in Philadelphia, August 14. Courses will be fitted to the specific requirements of customers who send employes to the school. Classes will be held on a three, five, and 13-week basis.

The shorter courses will be for concentrated product instruction, the longer courses for more comprehensive training in complete industrial instrumentation. The three-week course starts on August 14. The five-week classes will start Sept. 11 and Oct. 30. The comprehensive 13-week course will be held from Sept. 11 to Dec. 8. Industries for which special process instrumentation classes will be held will be announced upon completion of the full schedule.

Will Make Air Pollution Controls

The Catalytic Combustion Corp., 4544 Grand River Ave., Detroit 8, Mich., has been established recently to design and manufacture catalytic elements for use in fume incinerators and other air pollution control devices. The development and application of such materials is the result of a joint research project carried on during the past 4½ years by R. J. Ruff, president, Michigan Oven Co., and H. R. Suter, associate director of research, Wyandotte Chemicals Corp.

Administration of the pending Suter-Ruff patents will be under the control of the new company. Manufacturing facilities have been leased in Wisconsin and production equipment installed. Officers of the new company are R. J. Ruff, president; H. R. Suter vice-president; and N. C. Ruff, secretary-treasurer.

Du Pont Announces Personnel Moves

Dr. John M. Herndon, assistant manager of the Chambers Works, Deepwater Pt., N. J., has been named director of manufacture of the Du Pont Co.'s organic chemicals department. Before going to Chambers

Works, Dr. Herndon was production manager of the Petroleum Chemicals Division. He has been with Du Pont since 1933, the year he received his Ph. D. from Pennsylvania State College.

Alfred R. Mullis, a Petroleum Chemicals Division service representative in the Gulf Coast district since joining Du Pont in 1947, has been appointed manager of the Gulf Coast district office with headquarters in Houston. A graduate from Rice Institute in 1938, Mr. Mullis entered the oil industry as an employe of the research and development department of Humble Oil & Refining Co. in Baytown.

News of Personnel

Marley Co., Inc.—Jim C. Chase has been named manager of the recently expanded DriCooler sales department. He has been located at the general offices in Kansas City, Kans., since joining the company late in 1948.

Penn Industrial Instrument Corp.—George D. Keller has been appointed manager of the sales-engineering department.

Kennedy Valve Mfg. Co.—J. Lawrence Kennedy has been elected vice-president and secretary and a member of the board of directors. Before joining the Kennedy organization in 1949, he was vice-president of Charles L. Rumrill & Co., a Rochester, N. Y. advertising agency.

General Refractories Co.—James P. Raugh, who joined the Grefco sales force in 1928, was elected a vice-president last month. He had risen to the post of general sales manager in 1942 when he was called to active duty by the U. S. Navy. Following his return in 1945, Mr. Raugh was general works manager until his recent election as an officer in the company.

Air Preheater Corp.—William H. Larkin, previously with the Sturtevant Division of Westinghouse in charge of power plant work for the eastern district, has joined Air Preheater's sales organization in New York.

Petrolite Corp., Ltd., Tretolite Co. Division—Vice-president Melvin DeGroote, in charge of research, development, and patents, was awarded The Ohio State University's Lamme Medal at commencement exercises last month. The Lamme Medal is one of Ohio State's highest awards, given annually to a graduate in recognition of "meritorious achievement in engineering or the technical arts." Mr. DeGroote was graduated in 1915 with a B. S. in Ch. E., and later earned the professional degree of

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News of Suppliers

Chemical Engineer. He holds some 518 patents, either as sole or joint inventor, the majority of which are concerned with chemical demulsification and dehydration of emulsified crude oils.

Byron Jackson Co.—Carlos Bartolero has been appointed project sales engineer of the pump division, with headquarters in Los Angeles. He will spend most of his time in the field, being concerned with problems of pumping in the petroleum processing industries and pipe lines.

Expansion, Transition

Stainless Products Corp, New York City has been formed to market tanks of stainless steel and allied metals on a worldwide basis. The tanks are products of the former Stainless Welding and Mfg. Co. Portersville, Penna., and the new sales company will sell and service the entire production of this factory. Headquarters have been established in the Graybar Bldg., 420 Lexington Ave., New York.

BIF Industries of Canada Ltd., a subsidiary of **Builders Iron Foundry,** was formed early in June for the manufacture of certain products made by Builders-Providence, Inc., and Omega Machine Co. In particular, BIF will produce Venturi meters, flow controllers and gages, Chlorinizers, chlorine gas feeders, and Omega gravimetric and volumetric chemical feeders. Sales will continue to be handled by Keith Mercer, Reg'd., 1100 Craig St., East, Montreal 24, Quebec; Control and Metering Ltd., 454 King St., West, Toronto 2B, Ontario; and Bayfield and Archibald, 448 Seymour St., Vancouver, B. C.

Branches, Distributors

Yarnall-Waring Co. has announced the following changes in the Yarway sales organization:

Lytton C. Musselman in charge of Los Angeles district at company office in Huntington Park, Calif.; Power Engrg. Co. as representative in Salt Lake City; Wallace J. Agren as sales engineer in Chicago branch, replacing F. C. Harry Vaughan, deceased; R. W. Westlake as sales engineer in Cleveland branch; Andrew M. Ritter as district manager at Detroit, replacing Charles H. Grosjean who returns to New York territory; Lyle G. Chase, Jr., who joins the New York staff.

United States Gasket Co., Camden, N. J., has named W. S. Shamban & Co., Los Angeles, as exclusive representative for the state of California for the complete line of gaskets and packing, including the "Chemiseal" Teflon products.

Use Du Pont Services to...

Save Time... Save Trouble... Save Money in Making Better Gasoline

TEL USE—The Du Pont Representative provides useful services on all problems related to the use of Tetraethyl Lead Compounds and other additives. He can be called upon for advice on efficient utilization of TEL Compounds or to supervise TEL blending plant maintenance and repair work and to advise on tank entries.

PLANNING—Whether you are building a new blending plant, selecting a site, or want to provide for future expansion of your present blending facilities, the Du Pont Representative will work with you. Through him you can obtain standard or special plans and specifications as well as actual on-the-spot assistance.

EMERGENCY AID—Du Pont Representatives are always available to assist in taking care of special or emergency problems such as those that might be caused by a damaged shipment of TEL compounds, a leaking valve, a ruptured tank or any problem of this nature.

Assistance in TEL handling starts with blending plant design.

Operators are instructed in proper unloading procedures.

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BETTER THINGS FOR BETTER LIVING

... Through Chemistry

USE DU PONT TETRAETHYL LEAD COMPOUNDS

Results of Field Laboratory investigations check a refiner's own findings as well as having many other uses.

Quarterly inspections of blending plants are only one of the services insuring peak operating efficiency at all times.

Du Pont Services Meet Many Blending Problems

Representatives are always available for assistance when repair or maintenance is required.

Blending plant repair parts and complete safety equipment are maintained in each district for quick use.

Du Pont Representatives provide those technical, safety, and medical services that directly contribute to blending plant efficiency and to refining economies. This is part of a planned Du Pont program designed to aid the refiner in making better gasolines . . . more economically.

DID YOU KNOW

That Du Pont neoprene packings make possible the efficient testing of extremely deep wells. Neoprene, because of its abrasion resistance, heat resistance and imperviousness to attack by oils is used in many oil field and refinery operations.

MAKE DU PONT THE SOURCE FOR ALL OF YOUR GASOLINE ADDITIVES ▶ TETRAETHYL LEAD COMPOUNDS (*Motor Mix—Aviation Mix*) ANTIOXIDANTS • METAL DEACTIVATOR • DYES

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A-7

Book Reviews

Natural Gas, Gasoline Subject Of Latest in Chemical Series

Natural Gas and Natural Gasoline, 1st Edition, By R. L. Huntington, 6 x 9, vii + 598 pages, fabrikoid binding, illustrated, indexed, $8.00. Part of Chemical Engineering Series. McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y.

The purpose of this new text, written by the professor of engineering, University of Oklahoma, is to give a general idea of the natural gas and natural gasoline branches of the oil industry. It has been prepared as a text for student engineers in courses on production of natural gas from its various sources and the manufacture of liquefied petroleum hydrocarbons from it. It will be especially useful for its historical and economic aspects and to the graduate engineer who has not had specific training in this field.

There are 11 chapters and seven appendices plus author and subject indexes. The first chapter, an introduction, is largely an historical review of the industry, while the second discusses estimation of gas and gasoline reserves, including field methods of testing and sampling, and various laboratory procedures as well as a discussion of the various types of production.

Chapter 3 discusses elements of plant location and design. Subjects of other chapters include gas gathering and residue return, determination of cycling efficiencies, elements of natural gasoline processing, absorption, distillation and fractionation, gas dehydration, storage and transportation and high pressure pipeline research. The appendices give the physical properties of hydrocarbons, official specifications and test methods for natural gasoline, standard casinghead gas contract, standard compression and charcoal tests for natural gasoline content determination, low temperature fractional analysis, Perco copper sweetening process, and miscellaneous conversion factors.

Two chapters, on cycling and gas dehydration, were contributed by other authors. Two other chapters, on absorption and fractionation, were co-authored.

The author has made extensive use of illustrative problems in showing the application of fundamental principles to the solution of practical problems involving design and operation of gas gathering and natural gasoline recovery systems. The practical approach is stressed. Recent advances in gas condensate, cycling, oil absorption, fractionation, gas dehydration and the like are included and many illustrative examples are worked out to clarify the presentation of certain points.

References to the applicable literature are given at the end of each chapter, following which are numerous problems to illustrate the chapter discussion.

Fire Protection Is Covered in Third API Practices Book

Recommended Practices for Refinery Inspections, Part III: Fire-Protection Equipment; 8 x 10¼ in., 48 pages, paper binding, $1.00. Order through J. A. McNally, American Petroleum Institute, 50 West 50th St., New York 20, N. Y.

Part III in the series of *Recommended Practices for Refinery Inspections* by the American Petroleum Institute covers the inspection of fire protection equipment in oil refineries. It is part of a continuing project initiated in 1938 by the API Division of Refining. Part I covering inspection of process equipment was issued in 1948, and Part II on pressure relieving devices in 1949. Three additional parts are now in process and will be published in the future. They will cover tanks and spheroids, instruments, and electrical equipment.

The present handbook is divided into nine sections, the first introducing the subject and explaining the kind of equipment requiring inspection, frequency of inspection, and responsibility. Following sections deal with fire pumps and pump houses, water systems, chemical extinguisher systems, first-aid extinguishers, hose and hose houses, automatic devices, alarms, and drainage. An appendix provides a collection of typical inspection report forms.

Carl Georgi Writes Book on Oils and Engine Lubrication

Motor Oils and Engine Lubrication, by Carl W. Georgi; 6 x 9 in., xii; +514 pages, stiff cloth binding, indexed, illustrated, $8.50. Reinhold Publishing Corp., 330 West 42 St., New York 18, N. Y.

In view of the wide usage of lubricating oils in internal combustion engines there has been a long-time need for a comprehensive reference book of the type presented here in *Motor Oils and Engine Lubrication*. The book provides a classified summary of some of the existing information on this subject. It has been compiled in two parts, the first of which deals with the manufacture of motor oils, their chemical and physical properties, and the methods of testing and evaluating performance characteristics. The second part covers the application of motor oils and the relation of oils and lubrication to engine design, operation, maintenance, breakdowns, and failures.

Considerable information is given concerning additives and new synthetic lubricating oils in addition to the refining of petroleum-based products. The relatively new phase of the field—oil reclaiming and re-refining—is discussed also.

The author is widely known in both the petroleum and automotive industries. He is technical director of the research laboratories of Quaker State Oil Refining Corp. and vice president of the Enterprise Oil Co., Inc. He is an active member of various technical committees in such organizations as the Society of Automotive Engineers, American Petroleum Institute, American Society for Testing Materials, Coordinating Research Council, National Lubricating Grease Institute, American Chemical Society, and American Society of Lubrication Engineers.

Government Publications

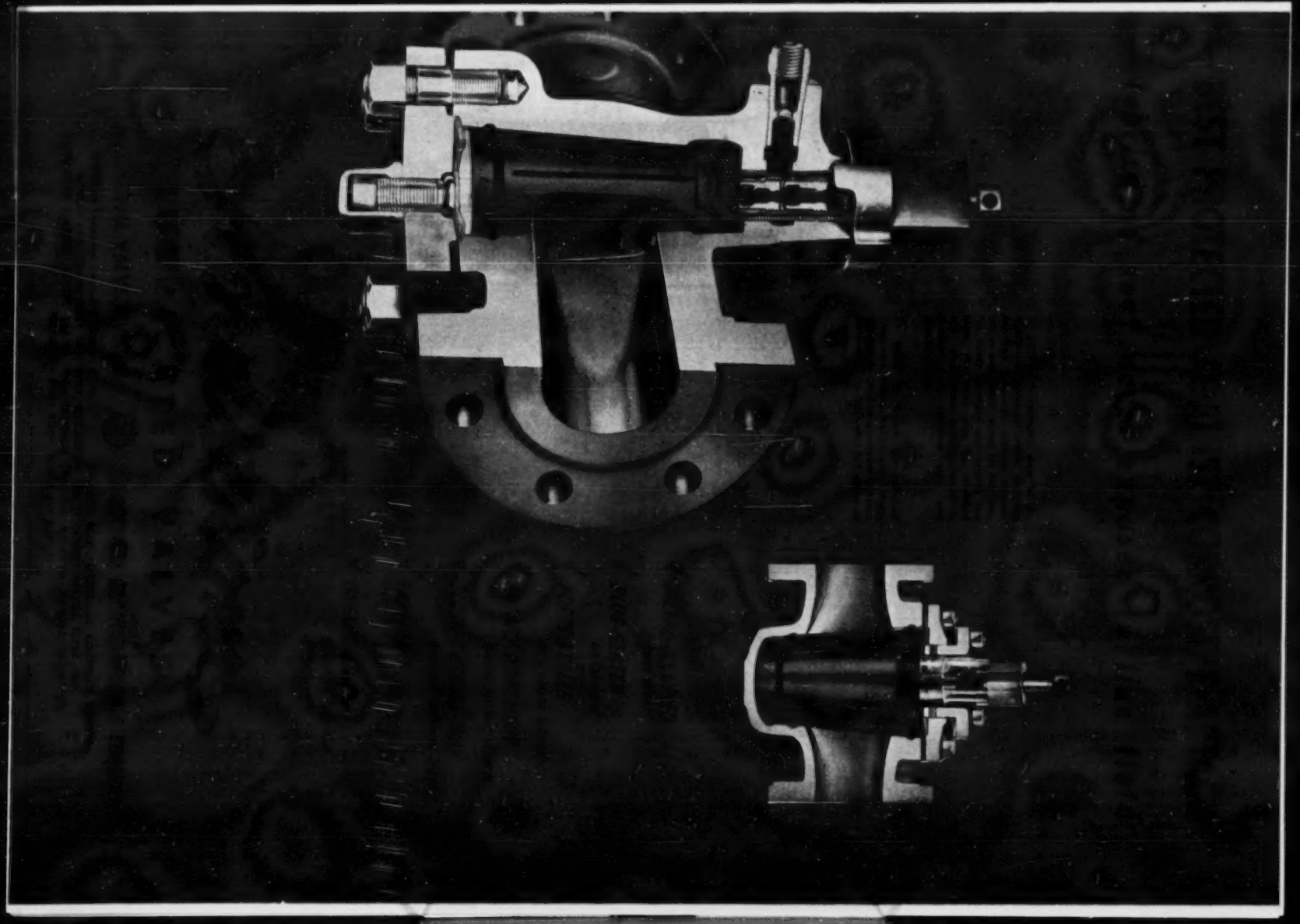
An Index of Oil-Shale Patents, Bulletin 468, compiled by Simon Klosky, Dept. of Interior, Bureau of Mines; 9 x 5¾ in., 650 pages, heavy paper binding, $1.50. Order from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Summary Report to the United States Bureau of Mines on Areas Suitable for Synthetic Liquid Fuel Plants in Western Kentucky, Northwestern Colorado, and Southwestern Texas; 8 x 10¼ in., 30 pages. Write to the Corps of Engineers, U. S. Army; Office, Chief of Engineers; Washington, D. C.

Association Publications

Review of Current Research and Directory of Member Institutions, 1949; The Engineering College Research Council of the American Society for Engineering Education; 6 x 9 in., 186 pages, paper binding, $1.75 postpaid. Address orders to F. M. Dawson, Chairman, Engineering College Research Council, c/o the College of Engineering, State University of Iowa, Iowa City, Iowa.

The V. I. Story, Varnished Insulations in Electrical Engineering, by David O. Woodbury; 5½ x 7½ in., 92 pages, paper binding, illustrated. Published by The Varnished Fabric and Paper Section, National Electrical Manufacturers Association, $1.00. Order direct from the Association, 155 East 44th Street, New York 17, N. Y.



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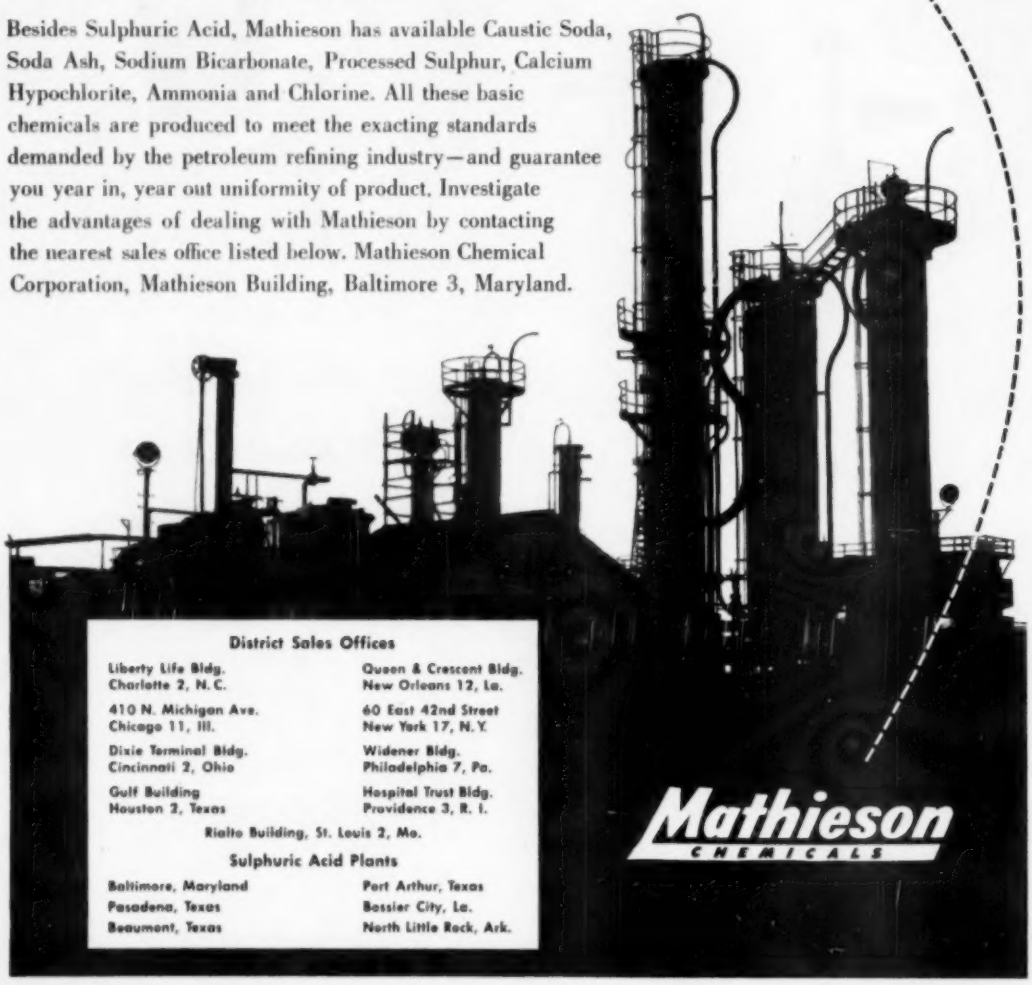

District Sales Offices

Liberty Life Bldg.
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Queen & Crescent Bldg.
New Orleans 12, La.

410 N. Michigan Ave.
Chicago 11, Ill.

60 East 42nd Street
New York 17, N. Y.

Dixie Terminal Bldg.
Cincinnati 2, Ohio

Widener Bldg.
Philadelphia 7, Pa.

Gulf Building
Houston 2, Texas

Hospital Trust Bldg.
Providence 3, R. I.

Rialto Building, St. Louis 2, Mo.

Sulphuric Acid Plants

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Port Arthur, Texas

Pasadena, Texas

Bossier City, La.

Beaumont, Texas

North Little Rock, Ark.

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REFINING TRENDS

Refinery Operations Stepped Up To Meet Peak Motor Fuel Demand

REFINERS in the U. S. late in June were operating close to 86% of capacity and running over 5,600,000 b/d of crude to stills. Motor fuel demand, however, is at a rate that is reducing gasoline stocks more sharply than in the same weeks a year ago. Heating oil output also is being maintained at a point that is building up kerosine and distillate stocks much faster than in this same period last year.

Crude Runs—A further increase in the rate of domestic runs to stills is indicated for June and about the same rate on foreign crude, total runs being indicated as 8.3% above June a year ago. A moderate further increase in total runs to 5,630,000 b/d in July is forecast by the Bureau of Mines. The present increases in runs may be in part due to the refinery shutdowns in April caused by strikes.

The revised Bureau of Mines forecast of crude runs for the 3d quarter is 5,610,000 b/d, about 3% higher than its previous forecast. The revised figure for the 4th quarter, 5,650,000 b/d, is around 1.7% higher than previously forecast.

Motor Fuel—Indicated rate of supply for June is the highest of the year to date, and also represents the largest rate of increase over the corresponding month of last year. For 5 months the rate of increase is about 2% above 1949, while in June it is around 6% higher. Indicated rate of demand for June is nearly 7% greater than a year ago while for 5 months demand has been about 4.5% larger than in the same period in 1949. Bureau of Mines revised forecast of motor fuel demand for the 3d and 4th quarters is unchanged and remains for the two quarters about 4% higher than actual demand in the same quarters in 1949.

Gasoline stocks at the end of June, it is indicated, were about at the same level as June 30, 1949, around 114,000,000 bbls. However, the reduction this year from the high point of March 31 has been 19,700,000 bbls., while in 1949 the reduction from the 127,440,000 bbls. in storage March 31 to June 30 was only approximately 13,400,000 bbls. The present rate of reduction in gasoline stocks if continued might serve to bring stocks by Sept. 30 closer to the 90,500,000-bbl. figure of Sept. 30, 1948, than to the 101,800,000-bbl. figure of Sept. 30, 1949, which was regarded as unduly high.

Heating Oils — Indicated refinery output of kerosine and distillates in June is running about 30% greater than in June a year ago, while for 5 months the rate of production has been about 8.5% higher than in the same period in 1949. For 5 months heating oil demand has been about 18% larger than for the same 5 months in 1949. The Bureau of Mines revised forecasts of heating oil demand indicate a 3d quarter demand 3.5% better than actual demand in 1949 and a 4th quarter demand nearly 14% larger. Unseasonally mild weather held down actual consumption in the last months of 1949.

Total kerosine and distillate stocks are around 75,000,000 bbls. as of the last of June. This compares with around 88,400,000 bbls. in stocks the end of June, 1949. A year ago the buildup in stocks was at the rate of 240,000 bbls. daily from 66,700,000 bbls. on March 31. This year the buildup has been from around 50,000,000 bbls. on April 30, and has been at a daily rate of over 400,000 bbls.

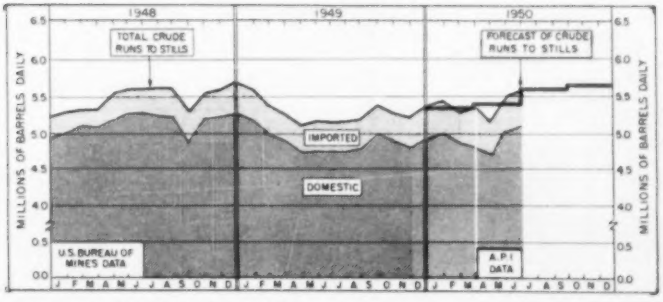
Residual Fuels—Refinery output in June was about at the 1949 rate but increased imports brought the total supply to nearly 10% larger. For 5 months refinery production has been about 7.8% less than for the 1949 period but the volume of imports has been doubled and total supply 3.6% greater. Indicated demand in June was 4.4% higher than a year ago and demand for 5 months 12.4% larger.

Total residual fuel stocks, at around 41,300,000 bbls. late in June, are around 35% less than a year ago. A large part of this drop is due to the continuing pull on California residual fuel stocks. At around 17,500,000 bbls., these stocks are only half the volume California refiners were carrying at the end of last June.

Bureau Revises Forecasts

The lines on the accompanying charts showing forecasts of crude runs to stills, motor fuel demand, heating oil demand, and residual fuel oil demand have been revised in line with the Bureau of Mines Revised Forecast for 1950 issued in June.

Fig. 1, Runs Highest Since January, 1949



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
June '50 API*	5,118	472	[1]5,590
June '49 BM	4,750	412	5,162
Change	+368	+60	+428
% Change	7.7	14.5	8.3

* Through June 24.

Total (1000 bbls.)
(Bureau of Mines Data)

5 Mo. '50*	740,172	69,873	810,650
5 Mo. '49	748,626	61,304	809,930
Change	—7,849	+8,569	+720
% Change	1.0	13.9	0.1

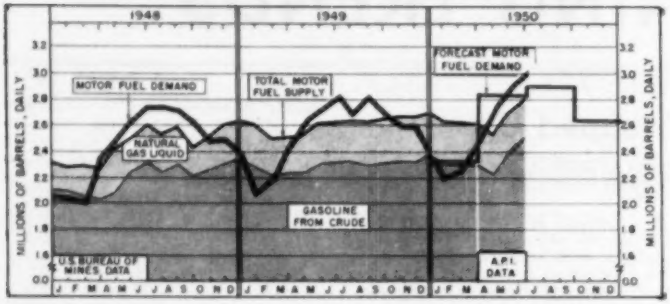
* May from API data.

BM Forecast of Runs to Stills
(1000 b/d avg.—Revised in June)
3rd Quar., 5,610; 4th Quar., 5,650; 1950, 5,514

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
June '50 API	44.7	5.1	17.8	18.9
May '50 API	43.8	5.6	18.6	19.3
April '50 BM	43.6	5.7	18.8	20.1
June '49 BM	45.9	4.4	15.1	20.4

Fig. 2, Motor Fuel Demand Tops 3,000,000 B/D



Natural Gas Liquids include natural gasoline blended at refineries, and used direct as motor fuel.

Fig. 3, Drop in Gasoline Stocks Larger Than in '49

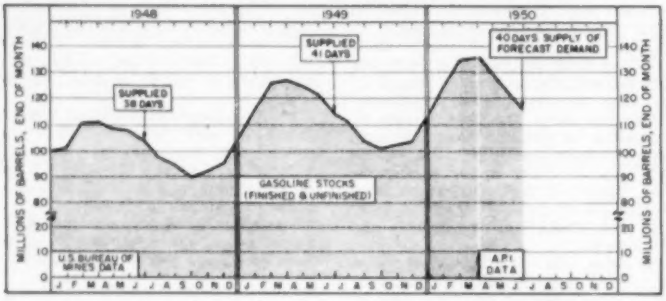

1948
1949
1950
SUPPLIED 38 DAYS
SUPPLIED 41 DAYS
40 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D

Fig. 4, Heating Oil Output at High Level

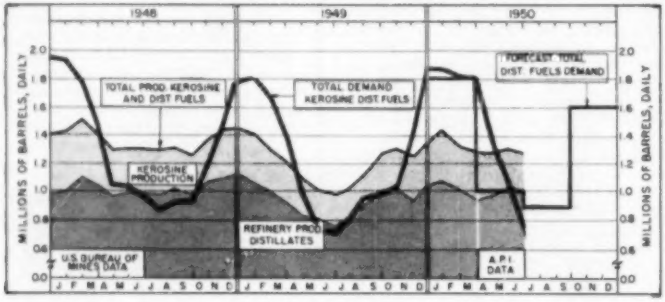
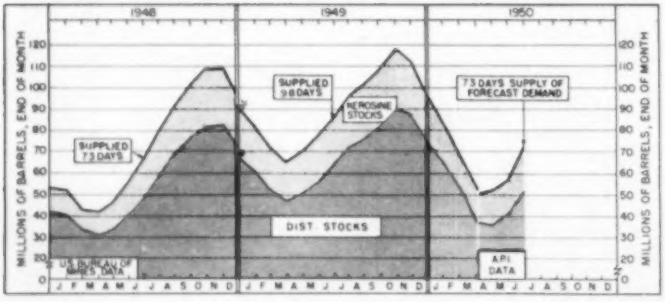


Fig. 5, High Rate of Buildup in Heating Oil Stocks



* Change in reporting in California eliminated 4,500,000 bbls. from distillate classification.

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
June '50 API*	2,500	315	2,815
June 49 BM	2,353	293	2,646
Change	+147	+22	+169
% Change	6.2	7.5	6.4

* Through June 24.

Total (1000 bbls.) (Bureau of Mines Data)

5 Mo. '50	351,555	46,626	398,181
5 Mo. '49	346,855	43,625	390,480
Change	+4,700	+3,001	+7,701
% Change	1.4	6.9	1.9

* May from API data.

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

June '50 API	3,101
June '49 BM	2,896
Change	+205
% Change	7.1

* Through June 24.

Total (1000 bbls.) (Bureau of Mines Data)

5 Mo. '50*	387,638
5 Mo. '49	370,950
Change	+16,688
% Change	4.5

* May from API data.

BM Forecast of Motor Fuel Demand
(1000 b/d avg.—Revised in June)
3rd Quar., 2,902; 4th Quar., 2,674; 1950, 2,712

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

June '50 API*	115,936
May '50 API	121,897
April '50 BM	128,937
June '49 BM	114,041

* On June 24th.

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
June '50 API*	287	999	1,286
June '49 BM	224	771	995
Change	+63	+228	+291
% Change	28.1	29.5	29.5

* Through June 24.

Total (1000 bbls.) (Bureau of Mines Data)

5 Mo. '50*	49,105	151,271	200,376
5 Mo. '49	43,828	140,612	184,440
Change	+5,277	+10,659	+15,936
% Change	12.4	7.6	8.6

* May from API data.

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
June '50 API*	147	627	774
June '49 BM	154	579	733
Change	—7	+48	+41
% Change	4.5	8.3	5.6

* Through June 24.

Total (1000 bbls.) (Bureau of Mines Data)

5 Mo. '50*	53,166	185,834	239,000
5 Mo. '49	46,177	156,175	202,352
Change	+6,989	+29,659	+36,648
% Change	15.1	18.9	18.1

* May from API data.

BM Forecast of Heating Oil Demand
(1000 b/d avg.—Revised in June)
3rd Quar., 967; 4th Quar., 1,685; 1950, 1,386

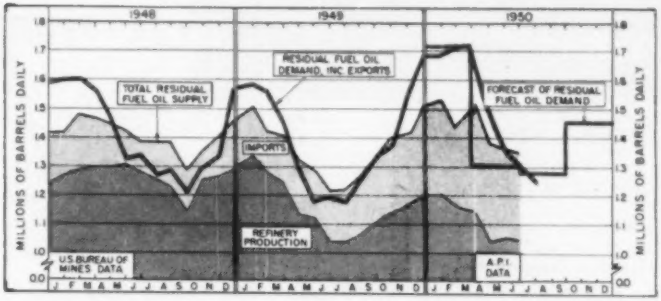
Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
June '50 API*	29,165	50,580	79,745
May '50 API	16,815	41,659	58,474
April '50 BM	13,383	37,530	50,913
June '49 BM	23,648	64,730	88,378

* June 24.

Fig. 6, Residuals Supply Seasonally High



Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
June '50 API*	1,060	280	1,340
June '49 BM	1,041	180	1,221
Change	+19	+100	+119
% Change	1.8	55.5	9.7

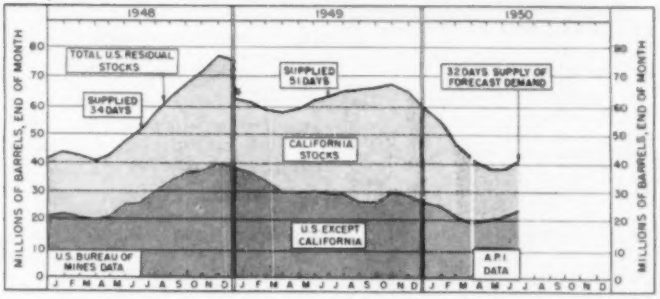
* Through June 24.

Total (1000 bbls.)
(Bureau of Mines Data)

5 Mo. '50*	170,317	48,712	219,029
5 Mo. '49	186,593	24,847	211,440
Change	—16,276	+23,865	+7,589
% Change	8.7	96.0	3.6

* May from API data.

Fig. 7, Calif. "Resid" Stocks Continue to Drop



* Change in reporting in California eliminated 13,000,000 bbls. from residual classification.

Residual Fuels Demand

Daily Average (1000 bbls.)

June '50 API*	1,250
June '49 BM	1,198
Change	+52
% Change	4.4

* Through June 24.

Total Demand (1000 bbls.)
(Bureau of Mines data)

5 Mo. '50*	240,726
5 Mo. '49	214,210
Change	+26,516
% Change	12.4

* May from API data.

BM Forecast of Residual Fuel Demand
(1000 b/d avg.—Revised in June)
3rd Quar., 1,393; 4th Quar., 1,467; 1950, 1,449

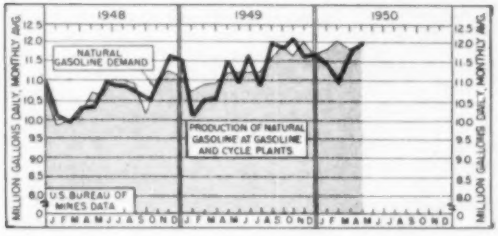
Residual Fuels Stocks

(1000 bbls. end of month)

	U.S. Except California	Total U.S.
June '50 API*	23,008	41,291
May '50 API	20,770	39,128
April '50 BM	20,039	39,979
June '49 BM	22,425	64,628

* June 24.

Fig. 8, Production and Demand of Natural Gas Liquids


1948
1949
1950
MILLION GALLONS DAILY, MONTHLY AVG.
NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

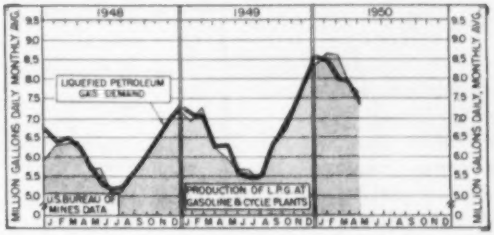
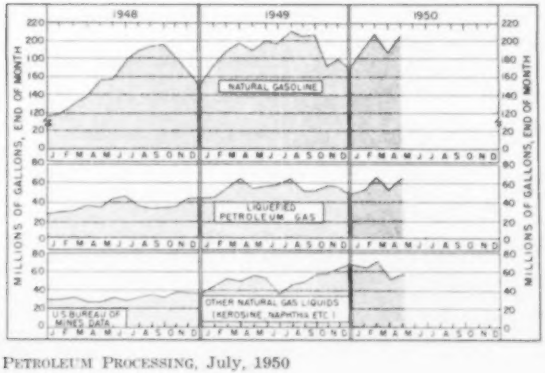

1948
1949
1950
MILLION GALLONS DAILY MONTHLY AVG.
LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF L.P.G. AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Fig. 9, Stocks of Natural Gas Liquids


1948
1949
1950
MILLIONS OF GALLONS, END OF MONTH
NATURAL GASOLINE
LIQUEFIED PETROLEUM GAS
OTHER NATURAL GAS LIQUIDS (KEROSINE NAPHTHA ETC.)
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Natural Gas Liquids Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

	Production (1000 gal./day avg.) Natural Gasoline	LPG**	TOTAL	Demand* (1000 gal./day avg.) Natural Gasoline	LPG	TOTAL
April '50	11,982	7,617	19,599	12,010	7,505	19,515
April '49	11,100	6,199	17,200	11,609	6,320	17,929
Change	+882	+1,517	+2,399	+419	+1,185	+1,595
% Change	7.9	24.1	13.9	3.5	18.7	8.9
	Total Production (1000 gal.)			Total Demand (1000 gal.)		
4 Mo. '50	1,425,424	979,694	2,404,518	1,387,366	968,359	2,355,495
4 Mo. '49	1,305,733	801,148	2,106,881	1,291,048	800,701	2,091,749
Change	+119,691	+177,946	+297,637	+96,258	+167,688	+263,946
% Change	9.2	22.2	14.1	7.5	20.9	12.6

	Stocks, End of Month (1000 gal.) By Type of Product: Natural Gasoline	LPG	Other Products†	By Location: Refineries	Gasoline Plants	TOTAL
April '50	207,717	66,397	59,805	87,738	246,181	333,919
March '50	204,012	64,511	55,221	74,886	248,858	323,744
April '49	196,734	57,317	56,379	84,210	226,220	304,630

* Demand, including exports but not transfers, is supplied from receipts from outside sources as well as current production and stock changes. Outside receipts totaled 3,760,000 gals. in March.

** Does not include LPG produced at refineries which in March totaled 98,952,000 gals.

† Includes kerosine, naphtha, specialty and other products.

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card. . .no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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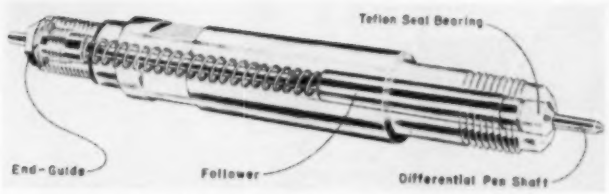
What's New!

EQUIPMENT . . . MATERIALS . . . PROCESSES . . . LITERATURE

Reviewed by WILLIAM C. UHL, Equipment Editor



Pen arm stuffing box with Teflon for cycling plant orifice meters

Cycling Plant Meter Leakage Reduced With Teflon in Pen Arm Stuffing Box

An orifice meter stuffing box, which is a combination packing and bearing machined from Teflon plastic, is said to reduce greatly maintenance and leakage troubles at the most frequent point of field service—the pen shaft, which lies between high pressure zones in the manometer and atmospheric pressure zones in the chart case. Pressure differentials of that magnitude, commonplace with natural gas transmission and in cycling plants, invariably cause stuffing box troubles. More than a year's field testing by several pipe line and oil companies (metering gas at cycling plants) has demonstrated good performance on various corrosive gases with entrained liquid, the manufacturer states. At one cycling plant the stuffing box is working at flow temperatures of 200° F. and pressure from 3600 to 4000 psi. Teflon, in addition to high chemical resistance, has a very low coefficient of friction and a perceptible, but minute, cold flow under pressure. In the new design a spring-loaded follower sleeve compresses the Teflon bearing in a gland shaped much like any conventional packing gland. The material flows slightly under pressure—acting in the manner of packing material and adjusting itself to the stuffing box body and to the shaft periphery. This bushing is tapered at each end and may be turned end for end on the shaft and will still line up, eliminating any bind. No lubricant is needed for sealing, although it may be applied without harming performance. The new stuffing box will be made standard on all Rockwell Emco orifice meters for low as well as high pressure use. Packaged kits comprising a new box and appropriate compensating links and pen arm are available for "converting" meters already in service. Pittsburgh Equitable Meter Division, Rockwell Mfg. Co.

Circle No. **1** *on Reply Card*

Gas Analyzer Indicates Toxic Ranges Of Hydrocarbon Halogen Derivatives

The Davis "Halide" Meter, originally perfected by E. I. du Pont de Nemours & Co., analyzes for the toxic range of halogen derivatives of hydrocarbons. It employs a photo-electric photometer to indicate changes in the intensity of the blue spectrum of a copper arc discharge in the presence of organic halide vapors. Readings are said to be accurate to within 10%, and the sensitivity for halide derivatives increases approximately as the number of halogen atoms per molecule. Manufacturer states the analyzer is particularly adaptable for detecting leaks of methyl chloride, dichlorodifluoromethane, methylene chloride, carbon tetrachloride, trichloroethylene, perchloroethylene, methyl bromide, etc. The instrument measures approximately 15 x 16 x 9¾ in., weighs 35 lbs., and operates on 110 v., 60 cycle A.C. It operates in accordance with a process covered by U.S. patent No. 1,990,706. The manufacturer, however, has been authorized to state that the patent will not for any reason be asserted against any person whatsoever. Davis Emergency Equipment Co., Inc.

Circle No. **2** *on Reply Card*

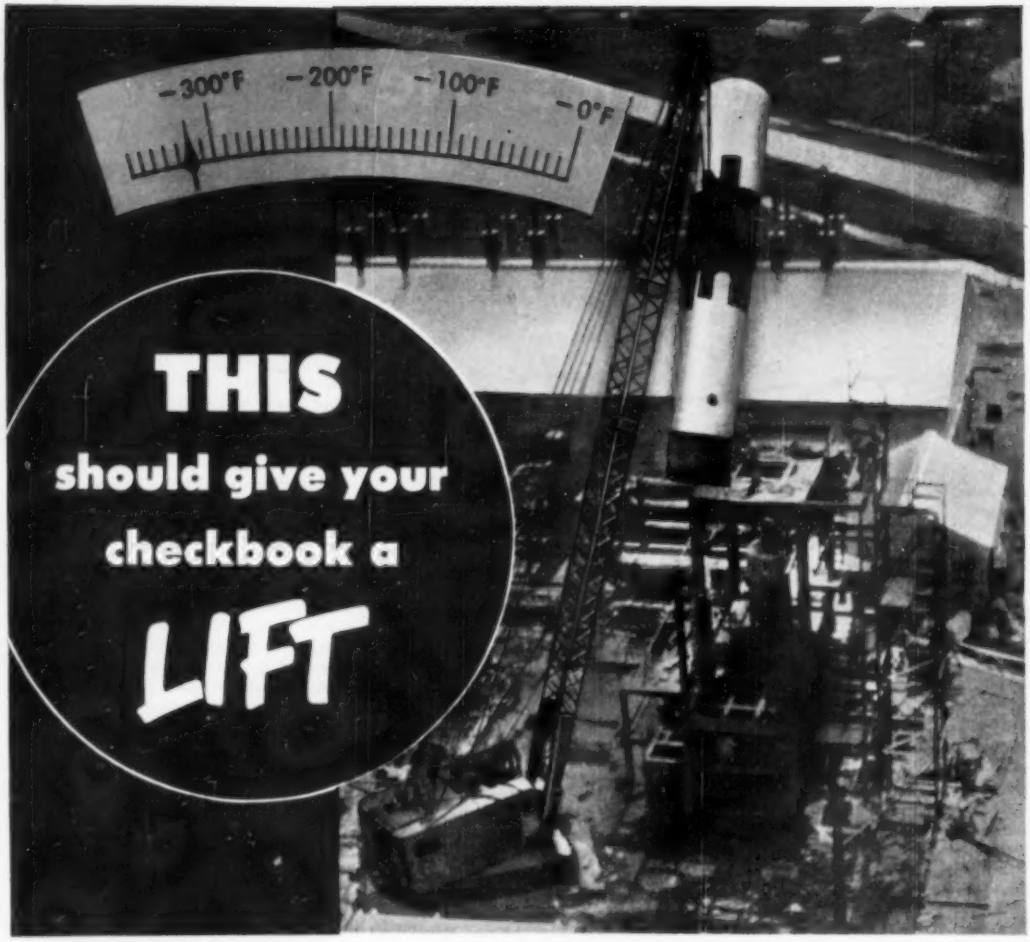
"Water Drop" Pressure Storage Tank Requires Less Steel in Construction

A new type of pressure storage tank is said to require less steel than other type pressure storage tank of the same capacity. It operates on the principle of a geometrically perfect shape and variable storage pressures dependent upon the quantity of product in the tank. The shell has a double curvature and is shaped like a drop of water on a flat surface. When the standard design tank is being filled, it is automatically maintained at 2½ psig. until the 40% rated capacity level is reached, after which it is maintained automatically at 5 psig. When emptying, it automatically reduces pressure to 2½ psig. at the 40% rated capacity level. Vacuum relief is at 2 oz. Marine Service Co.

Circle No. **3** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.



Ordinarily it would take two cranes to lift this oxygen plant bubble cap tower into position. But this is no ordinary tower. Made of Alcoa Aluminum, it weighs half as much as towers of heavy metals . . . handles far easier in fabrication, shipment and installation.

Also Alcoa Aluminum gets stronger and tougher as temperatures drop. It costs 25 to 50% less than other materials suitable for sub-zero processing.

Bubble Cap Towers of Alcoa Aluminum are now handling these chemicals

Formaldehyde	Furfural	Oxygen
Naval Stores	Benzene	Nitrogen
Coke Oven Gases	Naphthalene	Liquid Air
Hydrocyanic Acids	Solvent Naphtha	Acetone

Aluminum bubble caps are also used in many petroleum applications.

For more information, mail the coupon below to: ALUMINUM COMPANY OF AMERICA, 1477G Gulf Building, Pittsburgh 19, Pennsylvania.

Gentlemen:

Please send more information on aluminum's properties and applications for sub-zero process equipment.

Name

Title

Company

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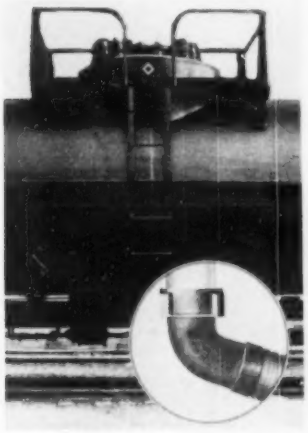
City State

ALCOA

FIRST IN **ALUMINUM**



Non-sparking Tank Car Coupling Is One-third the Weight of Conventional

A non-ferrous (non-sparking) elbow coupling for unloading tank cars has been developed which will allow one man to affix the coupling and eliminate the use of heavy, unwieldy wrenches. The coupling is 66⅔ lighter than a malleable iron fitting of similar duty. In the 4-in. size, a malleable coupling is about 15 lbs.; the new design is 4¾ lbs., it is said. Atlantic Metal Hose Co., Inc.

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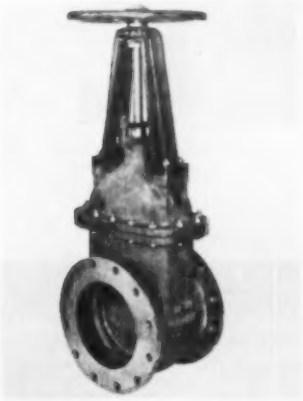
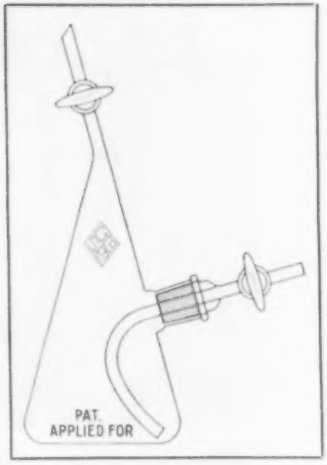


12-in. Size Added to Gate Valve Line In Various Corrosion-resistant Alloys

A 12-in., OS&Y, corrosion-resistant flanged, gate valve for 150 psi. at 500° F. (primary service rating), has been added to the "Pioneer" line, providing a complete range of sizes from ½-in. Designed for use in oil refining, chemical processing, and similar fields, the valve is available in Types 302, 304, 316 stainless steels and Pioneer metal for specific conditions. Face-to-face dimension is 14 in. Type 303 or 304 stainless is used for gland and bonnet bolts. Stems are double-acme threaded. Teflon packing rings are also standard. Manufacturer states valve conforms to MSS and recently developed ASA standards. Pioneer Alloy Products Co., Inc.,

Circle No. 5 on Reply Card



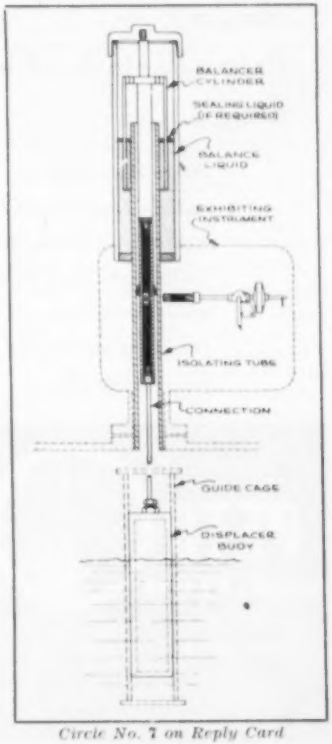
Combination Flask-Funnel Permits More Rapid Laboratory Analyses

More rapid analytical work is said to be possible with the new "Hustinx" heatable Flask - Separatory Funnel with stopcocks, made of Pyrex brand glass. The same container can be used for carrying out many operations without transferring to other flasks. It is recommended for weighing, drying, dissolving, mixing, concentrating, precipitating, cooling, heating, melting, boiling, distilling, evaporating, decanting, crystallizing, etc. It may also be used as a separatory funnel for both light and heavy liquids; for determining fatty acid content of soaps; and for operations which must be carried out in the presence of an inert gas. In standard separatory funnels only the heavy liquid can be drawn off. In this apparatus light liquids may also be drawn off. The flask is not turned upside down; rather, a heavy liquid is introduced through the side tube until the light liquid is expelled through the stopcock at the top. Scientific Glass Apparatus Co. Inc.

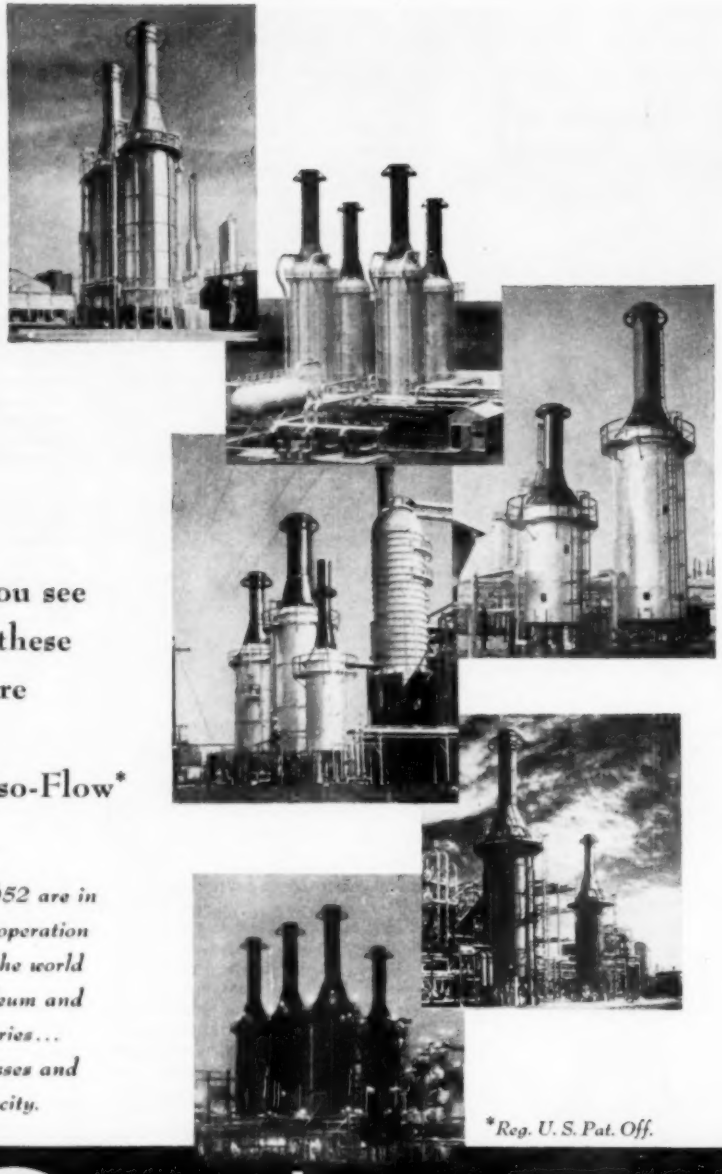
Circle No. 6 on Reply Card

Displacer-Buoy Instrument Handles Liquid Level Changes over 5 Inches

The force-balance principle has been applied to a new displacer-buoy, "Levelimeter" instrument for measuring liquid-level changes greater than five inches. By suitably selecting dimensions and properties of the displacer-buoy components, the total level change, whatever it may be, is caused to produce a total buoy travel of five inches, thus matching the standard travel of the transmitter. An electric impedance bridge or a magnetic transmitter can be used to transmit signals to an exhibiting instrument. The buoy consists of a rather long cylinder so loaded that its density is slightly less than that of the liquid of which the level is to be measured. Thus the buoy immerses to approximately half its depth in the liquid. Vertical movement is communicated to a balancer cylinder partially submerged in a well filled with mercury or other suitable liquid. Thus, while the buoy rises with rising liquid level, it rises a lesser distance than does the liquid. Conversely, the same action prevails with falling liquid level. Fischer & Porter Co.



Circle No. 7 on Reply Card



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More than 052 are in satisfactory operation throughout the world in the petroleum and allied industries... for all processes and for any capacity.

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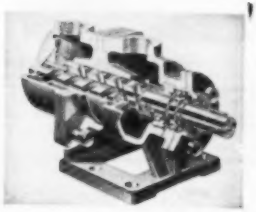
Efficient Laboratory Mixer Employs Combination Paddles and Baffles

Three baffles used in combination with adjustable speed, rotating paddles in the new "Fisher-Goldman" laboratory mixer provide for high efficiency in mixing action. Liquid is agitated both horizontally and vertically since the normal "whirlpool action" is eliminated and liquid is "folded" into itself. Manufacturer states operations are performed in as little as one-tenth the time previously required. The same design, in a larger industrial size, has been used to effect a tenfold saving in time for sulfonating castor oil, and a six-fold saving in time for processing coke by-products, it is claimed. The laboratory mixer has a Pyrex jar of 3½ gal. capacity with stainless steel parts. The 1/6 hp. motor can be obtained for 115 or 230 volt operation. Paddles are rotated at 275 rpm. Fisher Scientific Co.

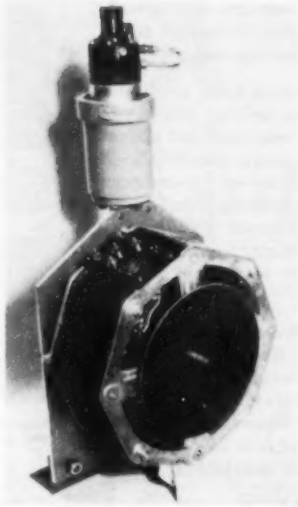
Circle No. **8** *on Reply Card*



Light Pump Made for Oil Burners, Lubrication, or Hydraulic Systems

The De Laval-IMO Series A313A pump has been designed for pumping petroleum products and other light or viscous fluids in volumes up to 85 gpm. against pressures up to 150 psi., as required for rotary and steam atomizing oil burners, oil transfer, lubrication, hydraulic systems, and similar service. It can be direct-connected to electric motors, turbines, or other high speed drivers without reduction gearing, belts, or chains. All parts are interchangeable. Mechanical seal requires no attention. Mounting can be in any position. Suction can be at top, bottom, horizontal left or right. De Laval Steam Turbine Co.

Circle No. **9** *on Reply Card*



Controller Converts Pneumatic Output To Electrical or Electronic Signals

The "CONO" Model EB Pneumatic Current Controller was developed primarily to permit the use of standard industrial pneumatic controllers on applications involving electrical components as the final controlled element. It provides a mechanism for using the output air of the pneumatic instrument to attain the 290 to 310° angular rotation required for full scale movement of most commonly used electrical components. Such assemblies can be used in systems for the control of temperature, flow, speed, pH, etc. Among principal uses would be temperature control of electrical furnaces, electrically heated stills and columns in pilot plants laboratories, and the like. Complete assembly comprises a pneumatic cylinder operator with accuracy and sensitivity of positioning to within 1/500th of total travel and a standard electrical component actuated by the device. Model EB utilizes either a standard "Variac" or "Powerstat" (unit illustrated), or can be had with a small rheostat-potentiometer for controlling the input to electronic devices such as the "Thymotrol," the "Mototrol," etc. Conoflow Corp.

Circle No. **10** *on Reply Card*

Portable Triple Flow Meter Kit Useful For Research, Pilot Plant or Field

A compact, portable kit has been developed with a wide flow metering range for research, pilot plant, and field work. The kit has three, integral, variable-area type, metering tubes with two special floats for each tube, made of Pyrex and tantalum. Range of the meter is 0.1 cc./min. to 0.5 gpm. of liquid, and 5 cc./min. to 2 cfm. of air. The unit can be equipped with brass or Type 316 stainless steel, built-in needle control valves. It is stocked in end fittings of steel, brass, aluminum, Types 303 and 316 stainless, hard rubber, nickel, Monel, Durimet, and Hastelloy "C". The total weight, including self-supporting legs and carrying handle, is 15 lbs. Brooks Rotameter Co.

Circle No. **11** *on Reply Card*

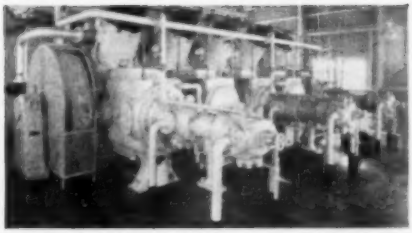
Cleaner Produces High Volume Water Jet at Twice Plant Steam Pressure

The new Sellers "Model B Hi-Pressure Jet Cleaner," useful for miscellaneous equipment, walkways, vessels, tanks and the like, provides a high temperature, large volume water jet at pressures adjustable to more than twice plant steam pressure. It comprises a venturi-injector mixing chamber which is connected to a steam and a cold water line, a 50-ft. length of high pressure hose, a cleaning lance, and a special nozzle. A control valve is provided for automatic addition of detergent or solvent in proportions from 0 to 10%. The combination of high temperature, large volume, and great hydraulic force is said to wash away easily grease, slime, carbon deposits, etc. that cannot be removed by any other method except hand scrubbing and scraping. Sellers Injector Corp.

Circle No. **12** *on Reply Card*

At Sun Oil's Starr County Plant . . .

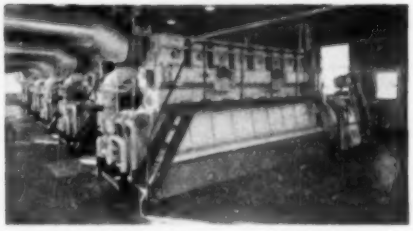
A 4-WAY JOB FOR MODERN COOPER-BESSEMERS



This 10-cylinder, 1100 hp GMV Turboflow compressor, known for extreme compactness and over-all operating economy, compresses residue gas from 1,000 to 2500 psi for return to field reservoir. Automatic control maintains constant pre-set discharge pressure.

In this new natural gasoline plant, engineered by Petroleum Engineering, Inc., there's good evidence of how well, how efficiently Cooper-Bessemer units of various types meet today's needs in power, compressing and pumping.

For in this one modern project, as shown here, you'll find Cooper-Bessemer in-line gas engines driving generators for all electric power requirements. And you'll find space-saving Cooper-Bessemer Twin-line pumps handling lean oil. These pumps in turn are direct-driven by compact Cooper-Bessemer GMX V-Type gas engines. Finally, last but not least, a 1,100 hp Cooper-Bessemer GMV Turboflow, tops today in compressor compactness and over-all economy, handles residue gas for return to a field reservoir.



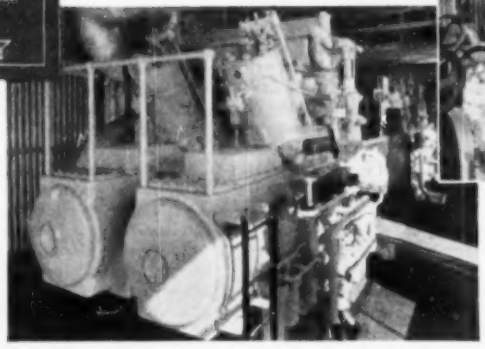
This line-up of Cooper-Bessemer gas engines in generating plant consists of four 600 hp, 8-cylinder JS's driving Ideal 400 kw generators and three 280 hp, 5-cylinder Type GS engines driving Ideal 200 kw generators.

Exterior of generator building showing muffler, air filter and oil cooler equipment.

To get at the reason *why* Cooper-Bessemers have been picked for all these services, you have only to weigh the important new developments introduced during recent years by one of America's *oldest* builders of engines and allied machinery.

Another Example of Efficient Power at Lower Cost

One of two Cooper-Bessemer Twin-line lean oil pumps in Sun Oil Starr County plant. High pressure side (foreground) is designed to operate on 41 API gravity lean oil, from 230 to 1100 psi while handling 248 gpm. Other side, in series, operates from 20 to 225 psi while handling 388 gpm.



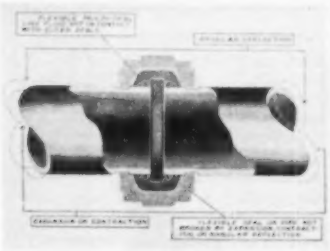
Two Cooper-Bessemer GMX-4, V-Type gas engines, each direct-driving a Twin-line 6-cylinder lean oil pump through fire wall. Each GMX is rated 200 hp at 400 rpm.

The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York City Washington, D. C. Bradford, Pa. Parkersburg, W. Va. San Francisco, Calif. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La. St. Louis, Mo. Los Angeles, Calif. Caracas, Venezuela Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

What's New!



Flexibility and Automatic Alignment Featured in Couplings, 2 to 20-in.

The "Dillon" flexible locked couplings, in 15 sizes from 2 to 20-in., are used in processing plants above or below ground, under water, exposed to abnormal stresses, vibrations, or earth movement. They have applications in power plants, refineries, cycling and gasoline plants, where heavy tankage is installed, or on large pipe manifolds, compressor and engine installations, and the like. Coupling has a one-piece, synthetic gasket joining the two pipe ends that assures a tight seal whether used on pressure or vacuum lines. The flexibility furnishes positive seal at all times when applied properly, including expansion, contraction, and angular deflection. The joint is completed by securing only two bolts. Housing locks within pipe grooves. The synthetic ring gasket seals at three points of contact on each side of the pipe. Extra seals at each end of the pipe are not in contact with the line fluid. Couplings can be installed correctly and rapidly due to automatic self-aligning feature, consisting of a tapered bolt hole in the lug, supporting the bolt at each end and in the center. When half the coupling is in the groove, the other half will line up. The Dillon Co.

Circle No. **13** *on Reply Card*

Trade Literature

Unusual Combination Units

Kelloggram No. 3 (1950); is devoted to the design and engineering of two unique combination units in the modernization program of the Montreal refinery of British American Oil Co. Ltd.; one being a deasphalting and crude topping unit and the other a Fluid catalytic cracking and catalytic polymerization unit; both effecting high savings in furnace and intermediate storage needs. M. W. Kellogg Co.

Circle No. **14** *on Reply Card*

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Chemical Resistance

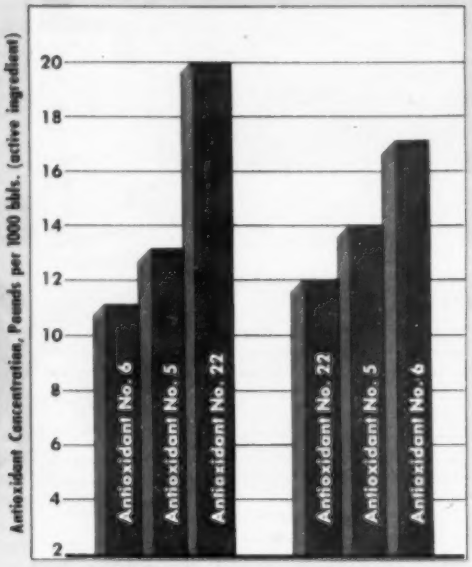
SOLUTION	% CHANGE dimensional	% CHANGE weight	SOLUTION	% CHANGE dimensional	% CHANGE weight
30% H_2SO_4	none	.062	toluene	none	.018
3% H_2SO_4	"	.091	heptane	"	.016
10% NaOH	"	.086	10% NaCl	"	.082
1% NaOH	"	0.10	distilled H_2O	"	0.10
95% ethanol	"	.053	10% HNO_3	"	0.10
50% ethanol	"	.085	10% HCl	"	.099
acetone	2.1	1.0	5% acetic acid	"	0.13
ethyl acetate	0.35	45	oleic acid	"	.078
ethylene dichloride	1.5	2.5	10% NH_4OH	"	0.25
CCl_4	none	.022	8% Na_2CO_3	"	0.11
Conc. HCl	"	0.067	3% H_2O_2	"	0.11

Test Method 7011, Federal Specification LP-406A.

houghton laboratories, inc. OLEAN, NEW YORK

[To obtain more data on advertised products see page 762]

Field Laboratories will evaluate Du Pont Gasoline Antioxidants for refiners.



Comparative antioxidant concentration, pounds per 1000 bbls. (active ingredient) needed to attain an induction period of 400 minutes.

Which of the Three Du Pont Antioxidants Is Most Economical in Your Gasoline?

If you have not checked the antioxidant responsiveness of your gasoline to *all three* Du Pont Antioxidants you may be paying a good deal more for antioxidant treatment than you need to. To meet variations in response of various gasolines, Du Pont offers *three* Gasoline Antioxidants . . . Nos. 5, 6, and 22.

A test with your gasoline, which you can perform in your own laboratory, or which we will be glad to make in the nearest District Laboratory, may reveal that one of the three antioxidants is considerably more economical to use. The bar charts above, made from actual laboratory tests, show the savings effected in two different gasolines.

Test requirements and methods of handling may also affect your choice of antioxidants. Antioxidant No. 6 usually provides the most economical control wherever copper dish gum specification is of importance. Where water extraction by tank bottoms or in pipelines is a problem, Antioxidant No. 22, with a low water solubility, is generally best.

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District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

What's New!

Refinery Paint Manual

Petroleum Refinery Paint Manual; 55 pages, indexed, leatherette bound booklet designed as a comprehensive guide for the painting of refineries and refining equipment; including suggestions for surface preparation, a recommended painting schedule for both interior and exterior surfaces, miscellaneous notes on painting, and application properties of the products recommended. Socony Paint Products Division, Socony-Vacuum Oil Co., Inc.

Circle No. **15** *on Reply Card*

Storage Tanks

Buffalo Standard Storage Tanks, a four-page folder giving sizes and dimensions on several lines of storage tanks, vertical and horizontal, ranging in capacities to 25,000 bbls. Buffalo Tank Corp.

Circle No. **16** *on Reply Card*

Pipe Fittings Catalog

Stockham Fittings, Catalog 50F; fabrikoid-bound, 118-page book, indexed, on cast iron and malleable pipe fittings for every pipe line use, with photographs and dimension drawings of each fitting; each listed size having price, weight, and dimensions; includes condensed engineering data, packing weights, and other information. Stockham Valves and Fittings.

Circle No. **17** *on Reply Card*

Industrial Oil Burners

Hauck Venturi High Pressure Atomizing Oil Burners, Catalog No. 456; eight pages of technical data, an explanation of the Venturi principle, and descriptions of the three flame types available (cylindrical, conical, and flat). Hauck Mfg. Co.

Circle No. **18** *on Reply Card*

Solvent Extraction

The Practical Way of Solvent Extraction, Bulletin No. 12; presents a complete description of the new patented York-Scheibel Liquid-Liquid Extraction Equipment, comparing it with fractional liquid extraction and fractional distillation for such applications as solvent refining of lube oils, and the like. Otto H. York Co., Inc.

Circle No. **19** *on Reply Card*

Hard-facing of Metal Parts

Haynes Alloys—Hard-Facing Manual, 40 pages telling how to select the right alloy; which welding process to use; and gives step-by-step instructions for applying various rods

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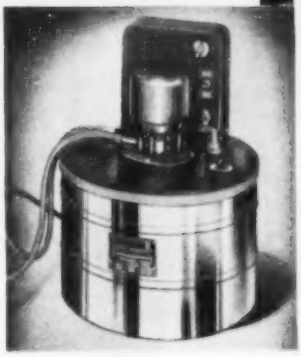

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by oxy-acetylene and metallic-arc processes; includes information on the properties and available sizes of 12 hard-facing materials. Haynes Stellite Division, Union Carbide and Carbon Corp.

Circle No. **20** *on Reply Card*

Gasoline Treating Plant

Heat Engineering for July, 1950, includes an illustrated eight-page article describing two-step extraction-conversion mercaptan treating in a plant with a treating capacity of 9000 b/d of thermally cracked naphtha of 0.245 wt.-% mercaptan content. Foster Wheeler Corp.

Circle No. **21** *on Reply Card*

Flow Meters

Foster Flow Tube, Bulletin FT; describes the principle of operation of the recently-developed "Gentile" patented primary element for measuring fluid flow which has no straight run limitations in installations, except before and after valves. Foster Engrg. Co.

Circle No. **22** *on Reply Card*

Water Treatment Equipment

Cochrane Hot Process Zeolite Water Conditioner, Publication 4801; four pages covering a new water treatment which is said to combine the advantages of hot process and zeolite softening. Cochrane Corp.

Circle No. **23** *on Reply Card*

Filter Clay, Catalyst Handling

Convair Pneumatic Conveying Systems, a 12-page bulletin presenting applications for pneumatic conveying systems which will handle materials ranging from 800 mesh to lumps 8 in. in size and up to 350 lbs./cu. ft. in weight, including clays, catalysts, etc. Convair Corp.

Circle No. **24** *on Reply Card*

Packless Expansion Joints

ADSCO "Corruflex" Packless Expansion Joints, Bulletin No. R-35-51; 16 pages explaining design and construction of a joint that requires no maintenance; includes sizes, temperature and pressure ratings, dimensions and weights, selection chart, installation practices; for pipe from 3 to 24 in. American District Steam Co.

Circle No. **25** *on Reply Card*

Storeroom Problems Solved

Frick-Gallagher Folder No. 220 explains "How to save up to 50% or more of floor space and cut manpower requirements in half," illustrating 25 types of rotary and stationary storage bin equipment and 18 accessories. Frick-Gallagher Mfg. Co.

Circle No. **26** *on Reply Card*

Nickel Alloy Technical Data

Engineering Properties of Inconel, Technical Bulletin T-7, revised March, 1950; and *Engineering Properties of "K" Monel and "KR" Monel,* Technical Bulletin T-9, revised December, 1949; two 24-page booklets containing charts, tables, on composition and properties, working instructions, and other pertinent information. International Nickel Co., Inc.

Circle No. **27** *on Reply Card*

Impulse Steam Trap in Stainless

Steam Traps, Bulletin T-1739; 16-pages of technical data, specifications, installation and operating suggestions, sizing instructions, and a general description of the "Yarway" Impulse Steam Trap, now being made with the body of Type 416 stainless steel bar stock for resistance to abrasive wear and corrosion. Yarnall-Waring Co.

Circle No. **28** *on Reply Card*

Flow Indicators & Controllers

Exhibiting and Controlling Instruments for Use with Flowrator Meters, Catalog 50: a 28-page booklet covering line of meters for all industries; including basic devices for coupling primary element to secondary or exhibiting instruments, the "Magabond" magnetic clutch, and the electric impedance bridge transmitting systems. Fischer & Porter Co.

Circle No. **29** *on Reply Card*

Uses for Stud Welding

Nelson Stud Welding in the Construction Industry, a four-page folder illustrating eleven different construction applications of stud welding including concrete reinforcing, guniting, insulation, electrical installations, and general building techniques. Morton Gregory Corp., Nelson Stud Welding Division.

Circle No. **30** *on Reply Card*

Liquid Bromine

Methods and Materials for Handling Liquid Bromine, 22 pages of detailed information, including schematic drawings showing recommended systems for handling the material in drums, and tank cars. The Dow Chemical Co.

Circle No. **31** *on Reply Card*

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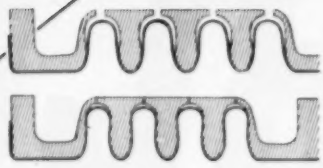
[To obtain more data on advertised products see page 762]

D-F S-E*



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D-F S-E could mean *definite financial savings effected*—actually D-F S-E does mean **Directed-Flexing Self-Equalizing*. Directed-Flexing, an exclusive construction feature in Badger Joints, is a combination of an all-curve corrugated member and correspondingly shaped Self-Equalizing rings which not only limits the movement of each corrugation but also progressively controls each increment of movement over the area of each corrugation. This construction eliminates localized stresses which cause metal fatigue and break-downs.

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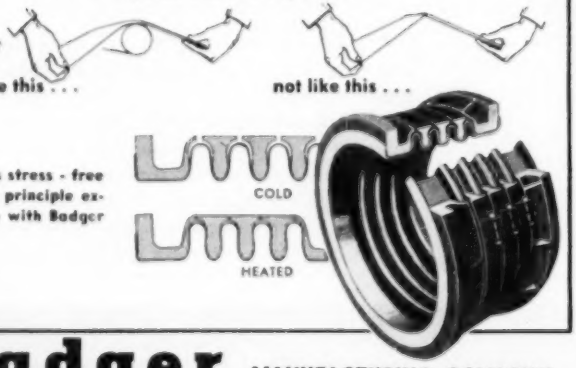

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What's New!

Paint Removal Procedures

How to Strip Paint with Oakite Materials & Methods, a 14-page, pocket-size folder explaining the removal of oil base and synthetic paints, enamels, and similar finishes from metal surfaces, covering the hot flow-on cold-spray, steam gun, and tank immersion methods. Oakite Products, Inc.

Circle No. **32** *on Reply Card*

Research Instrumentation

Instrumentation, Vol. 4, No. 5: includes an eight-page, illustrated article entitled "Instruments Accelerate Research, from Laboratory to Pilot Plant to Product." Brown Instrument Div., Minneapolis-Honeywell Regulator Co.

Circle No. **33** *on Reply Card*

Aluminum Stearates for Grease

Aluminum Stearate for the Grease Industry, Technical Service Report M-5, describes five grades of aluminum stearate, including pertinent technical data, effects on penetration, and the like. Witco Chemical Co.

Circle No. **34** *on Reply Card*

Pressure Vessel Fabrication

Fitzgibbons Boiler, a six-page folder describing and illustrating the manufacturing equipment, testing facilities, and operation of the Plate Products Division, Fitzgibbons Boiler Co., Inc.

Circle No. **35** *on Reply Card*

Tank & Structural Paints

Bitucote Protective Coating, a four-page folder describing applications for a general purpose emulsified asphalt paint for such structures as storage tanks, structural steel, and concrete buildings. Bitucote Products.

Circle No. **36** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

Personals

D. D. Buttolph, E. W. Evans and **P. W. Tucker** have been appointed by Phillips Petroleum Co. to various industry committees to replace **E. O. Mattocks,** who recently resigned from Phillips to take a position with the American Petroleum Institute.

Mr. Buttolph

Mr. Evans

Mr. Tucker

Mr. Buttolph, manager of the instrument and equipment branch in the chemical engineering division, has been appointed to committees of the American Gas Assn., the American Petroleum Institute, the Compressed Gas Assn., the National Fire Protection Assn., and the Liquefied Petroleum Gas Assn.

Mr. Evans, technical advisor on liquefied petroleum gas and chemicals, has been appointed to committees of the American Gas Assn., the American Petroleum Institute, the American Society for Testing Materials and the Liquefied Petroleum Gas Assn.

Mr. Tucker, also a technical advisor on liquefied petroleum gas and chemicals, has been appointed to committees of the Natural Gasoline Assn. of America, the Liquefied Petroleum Gas Assn. and the Manufacturing Chemists Assn.

* * *

The organizing committee for the Third World Petroleum Congress (to be held at The Hague, Holland, from May 28 to June 6, 1951) has announced the formation of a national committee for the U.S.A. Among industry leaders who have accepted membership in this new national committee are:

Mr. E. Bartholomew, general manager, research laboratories, Ethyl Corp., representing the Society of Automotive Engineers Inc.

Mr. F. S. Clulow, vice president of manufacturing, Shell Oil Co.

Dr. W. F. Faragher, research and development department head, Houdry Process Corp.

Dr. P. D. Foote, executive vice president, Gulf Research and Development Co.

Mr. A. P. Frame, president, Cities Service Research and Development Co.

Mr. C. G. Kirkbride, vice president in charge of research and development, Houdry Process Corp., representing the American Institute of Chemical Engineers.

Dr. E. V. Murphree, president, Standard Oil Development Co.

Dr. M. E. Spaght, president, Shell Development Co.

Harris Bateman has been named chief engineer for Cities Service Oil Co., Del., and Cities Service Pipe Line Co., and also director of Cities Service Oil Co.

Mr. Bateman was first employed in the engineering department of Cities Service at Bartlesville in 1927, after being graduated in civil enginering from Oklahoma A. & M. College. He was made purchasing agent in 1938 and held the position until 1942 when he was transferred to New York. There he served in key positions in the construction of such major projects as the large Cities Service refinery and the Cit-Con lubricating oil plant at Lake Charles, La., and the modernization of Cities Service's refinery at East Chicago, Ind. He was made coordinator of purchasing in 1949, a position he held until his present promotion.

* * *

Dr. Frederick D. Rossini, former chief of the thermochemistry and hydrocarbons section of the National Bureau of Standards, has been named to receive the Department of Com-

Heads Inspection, Safety Department at Tide Water Plant

A young lady of parts who holds down an unusual and responsible job in the oil industry is Miss Edwina Gilbert, in charge of the combined inspection and safety department at the Drumright, Okla., refinery of Tide Water Associated Oil Co. She has been successively photographer, chemist, engineer and now refinery inspector in her short career.

Miss Gilbert

Miss Gilbert majored in chemistry at Oklahoma A & M College, Stillwater. Leaving college in 1941 she worked in photographic shops in Dallas, Tulsa and Oklahoma City as a laboratory technician. She joined Tide Water as a chemist in the Drumright research laboratory in 1942.

The war having made inroads on Tide Water's engineering staff, she was transferred to this department the following year, doing such general engineering work as inspection of equipment, surveying, drafting, job estimating, and engineering calculations of all types. At that time engineering and inspection were combined. In 1949 the engineering and inspection work was split to form two departments, and Miss Gilbert took over as head of the inspection department with a two-man staff. Early this year safety matters were added to the responsibilities of the inspection department.

Photography now is but one of her hobbies—but she's good at it. To prove the pudding, she made the photographs accompanying the article in the June issue of PETROLEUM PROCESSING describing the new Houdriflow unit at the Drumright plant. In addition, she is greatly interested in football and basketball—is an enthusiastic A & M rooter. She likes to repair radios in her spare time, and moulds and shapes plexiglas.

Edwina grew up in the oil industry—was born on an oil lease in the old Muskogee (Okla.) oil field where her father was a pumper. As a child she learned to tail sucker rods and tinker with gas engines. She laughingly recalls slipping out at night to "help" her father when something went wrong with the engines at the old Reliance Oil Co. gasoline plant in the Muskogee field.

Men at the plant say there's no place in it where Edwina will not go when inspection duties require. "She gets just as dirty as the rest of us and never bats an eye about it," they comment. Small in stature, she finds it easy to squeeze into tight places in equipment.

And, what's more, she likes it.

merce Exceptional Service Award for his outstanding contribution to hydrocarbon research. On July 1, Dr. Rossini joined the faculty of Carnegie Institute of Technology as head of the chemistry department, where he will hold the new Silliman professorship in chemistry established recently by a grant from Gulf Oil Corp.

* * *

Keith Lewis, superintendent of Imperial Oil Ltd.'s Montreal East refinery, affiliate of Standard Oil Co., N. J., has been appointed superintendent of its new Winnipeg refinery.

Mr. Lewis was born in Belmont, Nova Scotia, and studied engineering at Dalhousie University and mechanical engineering at Nova Scotia Technical College. He joined Imperial in 1933 at its Halifax refinery after spending some time in survey and engineering work. In 1942 he joined St. Clair Processing Corp. as one of the specialists needed for Canadian wartime production of synthetic rubber, later becoming assistant manager. When St. Clair merged with Polymer Corp. Mr. Lewis returned to Imperial. He attended the advanced management course at the Harvard School of Business before his appointment as superintendent of Montreal East refinery in 1948.

Shell Development Co.'s research and development activities at Emeryville have been reorganized.

Appointed associate directors of development are **B. M. Beins,** mechanical engineering; **C. L. Raymond,** process engineering; **M. Souders, Jr.,** chemical engineering; and **D. L. Yabroff,** process development.

Other appointments include **C. R. Nelson,** department head of process engineering, with **A. J. Cherniavsky** and **G. E. Liedholm** as assistant department heads; **G. A. Nelson,** staff metallurgist; **W. E. Hand,** head of costing and appraisals; **P. D. Hishon,** chief draftsman, development; and **P. R. Hoyt** and **M. V. Long,** staff consultants, instrumentation. **D. J. Pompeo** will head a new department consolidating the instrument research and development groups of the company.

T. W. Evans, director of research, is head of the research division, while **A. J. Johnson,** vice president and director of development, will be in charge of the development division.

H. E. Randlett, Jr., has been appointed administrative assistant to the director of research.

* * *

Dr. Donald L. Katz, professor of chemistry at the University of Michigan, received the Hanlon Award from the Natural Gasoline Association of America during their 29th annual meeting at Fort Worth, Texas. Presentation was made by James E. Pew, Sun Oil Co. and NGAA president, who cited Mr. Katz for his work on retrograde condensation, phase behavior, and analogous problems in hydrocarbon chemistry that have been important to design and operation of plants.

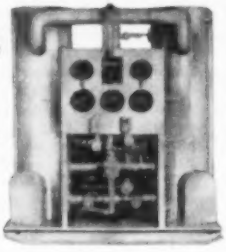
Mr. Katz received his B.S. degree in chemical engineering from Michigan in 1931 and Ph.D. degree from the same school in 1934. After a brief period with Phillips Petroleum Co., he returned to Michigan as an assistant professor in 1936 and was made full professor in 1943. He is the fourteenth recipient of this award.

* * *

Dr. Howard R. Snow, plant manager of Pan American Refining Corp.'s Texas City refinery and a member of the Board of Directors, has been elected vice president of the corporation. He will continue in his present position in the refinery.

He is a graduate of the University of Michigan, where he received both his master's degree and doctorate. In 1925 he joined Standard Oil Co. (Ind.) and in 1932 was made plant manager of their Neodesha, Kans., refinery. In 1942 he was appointed manager of Rubber Synthetics, Inc., a large butadiene plant which was being constructed in Gary, Ind., for the government. He went to Texas City from this assignment.

Pritchard's *New* HYDRYER*



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T. S. Zajac, corrosion engineer, Shell Oil Company, Houston, was elected chairman of the Natural Gasoline Association of America corrosion Research Project Committee at the recent semi-annual meeting of that group in Ft. Worth. He succeeds **W. H. Stewart,** Sun Oil Company, Beaumont, Texas, who has been chairman for the past two years. **F. A. Prange,** chief metallurgist, Phillips Petroleum Company, Bartlesville, Okla. was elected vice chairman of the committee.

These men together with **T. S. Bacon,** Lone Star Producing Company, Dallas, **H. E. Waldrip,** Gulf Oil Corporation, Houston and **P. P. Spafford,** Stanolind Oil & Gas Company will comprise the Steering Committee which will direct the activities of the committee in its seventh year of operation.

* * *

George F. Gast, supervisor of the steam and power department of Tide Water Associated Oil Co.'s Bayonne, N. J., refinery, retired from active service on June 14.

Mr. Gast started in Tide Water's mechanical department in 1918 and was made superintendent in 1920. He was transferred to the engineering department in 1932 and to the steam department as foreman in 1934. He was advanced to the position he held at the time of his retirement in 1945.

* * *

Albert M. Schaefer, night foreman at Indiana Standard Oil Co.'s Whiting, Ind., refinery has retired after 50 years of service. This half-century has been spent in the heavy oils division of the refinery, where he started when he was 14 years old. Mr. Schaefer has been presented a gold watch by **Dr. M. G. Paulus,** vice president in charge of manufacturing, from the company's Board of Directors.

* * *

M. R. Schmidt, general superintendent of Indiana Standard Oil Co.'s Whiting, Indiana, refinery, has retired after more than 32 years of service and has been succeeded by **A. F. Endres,** assistant general superintendent. **P. C. Livesay,** superintendent of projects division, succeeds Mr. Endres and **F. H. Blunck,** assistant superintendent of light oils division, succeeds Mr. Livesay.

* * *

M. M. Beckes, operating manager of the Lubrite division of Socony-Vacuum Oil Co., Inc., St. Louis, has succeeded **C. C. Benedict** as the company's regional operating manager in New York. Mr. Benedict retired on July 1.

* * *

Alfred R. Mullis has been appointed manager of the Gulf Coast district office of Du Pont's petroleum chemicals division. Prior to joining Du Pont in 1947, Mr. Mullis was with the research and development department of Humble Oil & Refining at Baytown, Tex. His new headquarters will be in Houston.

* * *

Milton R. Roychok is now chief chemist for the Rothschild Oil Co., Santa Fe Springs, Calif. He graduated in 1946 from Texas A. and M. College and was previously employed as research chemist by Shell Oil Co. and as chemist by General Petroleum Corp.

George Calingaert, Ethyl Corp., Detroit, has been appointed professor of chemistry at Hobart and William Smith Colleges, Geneva, N. Y., and will leave his present position as associate director of research on July 1.

* * *

R. C. Clark, refinery manager for Utah Oil Refining Co., has been appointed company director replacing **M. J. Greenwood,** who asked to be relieved of this position. Mr. Clark joined Utah Oil as an engineer in 1922.

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

New Rubber Program Needed – Now

THE turn of events in Asia has made it necessary for the government to adopt at once a sound synthetic rubber production program. We need one that will insure adequate supplies of the synthetic product in the event our receipts of the natural product should be cut off entirely, as in the last war.

Under the government's policy since the war, the output of synthetic rubber has dropped from a peak of 950,000 tons a year to around 300,000 tons at present. Recommendations were made to Congress a few weeks ago to make mandatory production of only 200,000 tons a year. Research in this important new industrial field has been greatly curtailed by the petroleum and rubber companies because of the restrictions and uncertainties of the present government policy.

President Truman's recommendations to Congress earlier in the year for disposing of the government's rubber plants to private industry do not form the basis for building a strong synthetic rubber industry in this country. To guard against the concentration of a new industry in the hands of a few companies, the President recommended that the plants not be sold to "dominant" interests in the synthetic rubber industry. This provision would automatically shut off from the acquisition of the plants such oil companies as Phillips Petroleum and Standard of New Jersey, which pioneered in the synthetic rubber industry and built and operated rubber plants during the war in connection with their refineries. It also would eliminate some of the large rubber companies. It is these same companies and others of their type which, through their experience and technological knowledge, could contribute the most to building up a sound synthetic rubber industry in this country.

Practically unlimited natural resources exist in this country for making ample supplies of synthetic rubber for all needs of this nation and its allies, if this became necessary. Oil industry technologists have pointed out that less than 1½% of our present crude oil production would make 2,000,000 tons a year of synthetic rubber. Enough butane can be extracted from the natural gas now being produced to make another 2,500,000 tons a year, the gas reserves being stored in safe underground bomb-proof shelters to be drawn upon as needed. The experience already developed in this field insures that synthetic rubber can be produced at costs that would not hamper the future growth in the use of rubber. The taking up again of research in this field would bring about substantial improvements in the quality of the synthetic product and its applications.

It has been pointed out to Congress that it would take at least six months under peacetime conditions to put the standby rubber plants in operation and train the personnel to run them. Their production would be at the rate of 675,000 tons a year, far less than our present requirements, while it would take at least a year for an established synthetic rubber industry to build new plants and start them operating.

Under these conditions, and in view of the international situation, Congress should at once take the necessary steps to strengthen greatly our national position in the production of synthetic rubber, to insure that technological advances continue and that the industry is capable of rapid expansion if necessary. This position can best be achieved by encouraging private industry to lease or buy the government plants, operate them and sell their products. The conditions of acquisition should depend only upon the individual company's ability and willingness to get into this new industry.

Closing of Gas Conservation Projects May Result from FPC Price Regulation

TEXAS Railroad Commission Chairman Wm. J. Murray, Jr., hit the nail on the head the other week when he said that recent government actions to "protect" the consumer from "unwarranted" increases in the price of natural gas will in fact hurt him and ultimately may make it "economically not feasible to construct additional gas conservation plants."

Government regulations, he said, can force reductions in the price of gas at the wellhead or natural gasoline plant by a few cents. This apparently would benefit the ultimate consumer by a 2 to 3% reduction in his gas bill. But that slight reduction to the consumer equals a 30 to 50% reduction in the price at the source of supply, he pointed out, and then declared: "Such a cut would again make conservation projects economically impossible."

Mr. Murray ably explained why this small reduction would ultimately harm the consumer. He said: "If these (natural gasoline) plants were closed down and the gas again wasted, the consumer would find himself in an era of growing scarcity and rising prices because of inadequate supply."

The Federal Power Commission long since has been upheld by the Supreme Court in its extra-legislative assumption of jurisdiction over the price of gas moving—or destined to move—in interstate commerce, "clear back to the wellhead." An attempt to correct this unwarranted assumption of authority, which Congress never intended FPC to have when it passed the Natural Gas Act creating FPC, died recently when the Kerr bill was vetoed.

Mr. Murray might well have pointed out an equally alarming potentiality stemming from FPC's alleged "consumer protecting" activities, which in fact are aimed at nationalizing the oil industry. If existing and future gas conservation programs are made economically impracticable through price regulation and gasoline plants shut down as a result, presumably state conservation authorities will be forced to shut in oil fields to prevent gas waste, and new ones may not be developed for the same reasons.

This action could promptly backfire into creating an artificial crude oil shortage and attendant higher prices all along the line. Then surely would come the proclamation of another "national emergency," about which enough propaganda could be spread to excuse the nationalization of the oil industry. State Socialism would then be that much closer.

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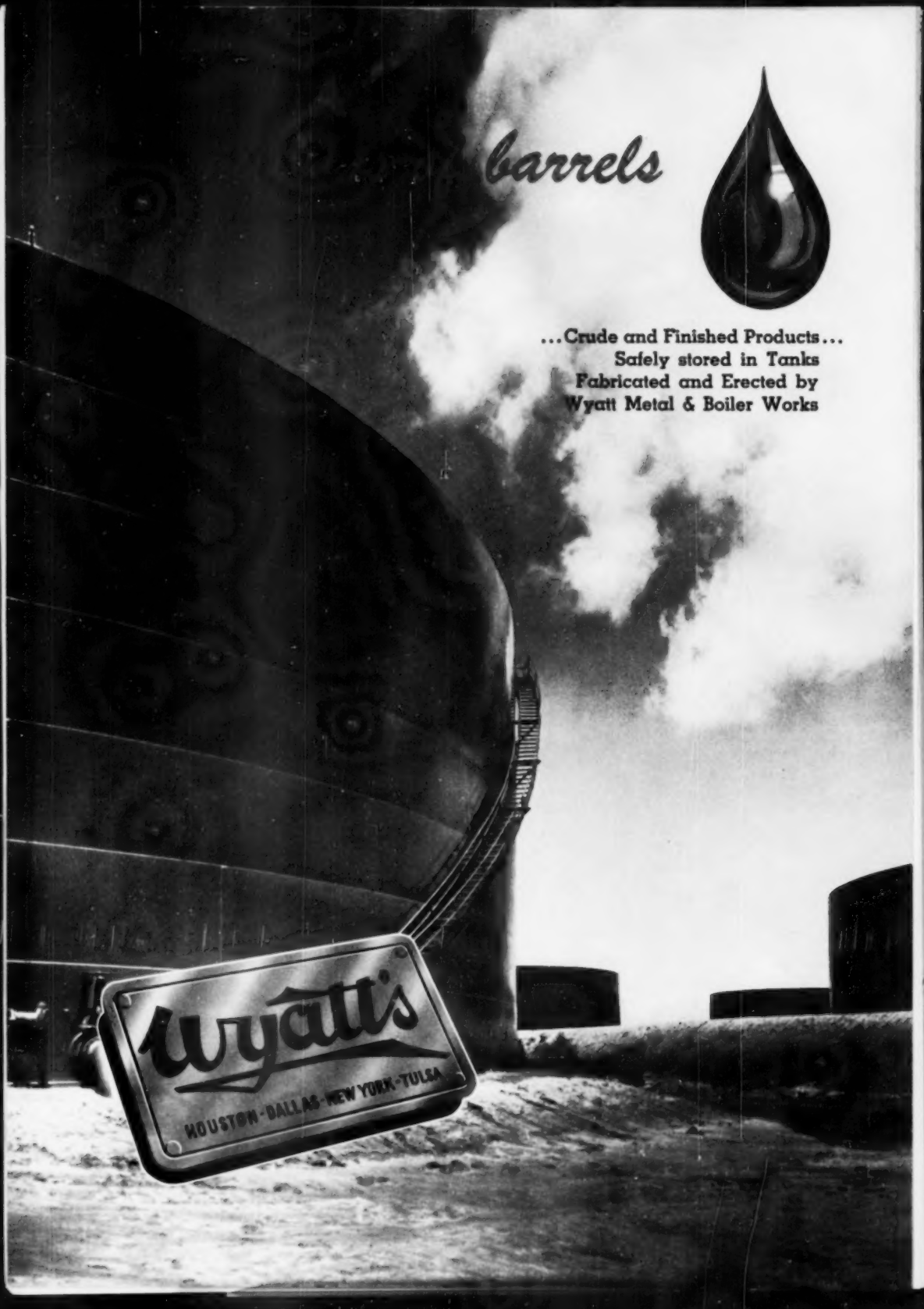
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